JOURNAL OF THE SMPTE

82d SMPTE Convention • October 4–9 • Sheraton Hotel, Philadelphia

volume 66 • number 8

AUGUST 1957

JOURNAL of the
SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

PUBLICATION OFFICE TWENTIETH AND NORTHAMPTON STREETS, EASTON, PA.

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SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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Entered as second-class matter January 15, 1930, at the Post Office at Easton, Pa., under the Act of March 3, 1879, and published monthly.

Printed by Mack Printing Company, Easton, Pa.

Journal of the Society of Motion Picture and Television Engineers

VOLUME 66 · NUMBER 8 · AUGUST 1957

Status of Video Tape in Broadcasting

By HOWARD A. CHINN

Video tape recording has been used for television broadcasting purposes since the Fall of 1956 primarily for time-zone delay (i.e., the delay of program material for presentation at the same clock time in each of several time zones). In this paper the Columbia Broadcasting System's experiences to date with this new medium are described and a typical equipment installation shown. In addition, some of the picture idiosyncrasies that can be produced by improper adjustment of the video tape recording equipment are illustrated. Photomicrographs showing video frequency modulation of magnetic tracks are presented together with examples of magnetic surface irregularities that can cause signal dropouts. The economics of video tape recording is touched upon and some of the design improvements that have been effected since the equipment was first put into service are described.

In November 1956, it was the good fortune of the Columbia Broadcasting System to be in a position to inaugurate the use of video tape recorders on a regular basis for the first time in the history of television broadcasting. In the intervening months, considerable experience has been gained in video tape recording and the conviction continues to grow that the process will have a tremendous impact upon the pattern of television broadcasting operations. In the following material some of CBS' experiences to date are recounted in three general areas, namely: (a) in technical operations; (b) with the tape itself, as a recording medium; and (c) with engineering design problems.

Video Recording Operations

The first broadcasting application of video tape recording (VTR) was for time-zone delay. Specifically, it was (and is still being) used for delaying the daily 15-minute *Doug Edward's News* program for two hours for the benefit of the CBS Pacific Network audience. After a week or so of closed-circuit trial runs early in November 1956, broadcasting operations were begun by recording the show in duplicate on video tape and backing this up with both 16mm and 35mm TV film recordings (TVR). On playback, all four recordings were run synchronously — obviously, every precaution was taken to insure against a failure.

After several successful and uneventful weeks of this operation, a weekly 30-minute show, namely, *Godfrey's Talent Scouts*, was tackled. Next a 45-minute program and then a one-hour program (in both cases, Ed Murrow's *See It Now*) were undertaken. Finally, a 90-minute program (*Cinderella*) was recorded and rebroadcast from tape.

While these air shows were being handled CBS also carried on a much more extensive daily recording and playback operation for personnel training and for equipment shakedown purposes. Complete programs were re-recorded and played back daily on a regularly scheduled basis. In play-back, however, the program material never got any further than a 75-ohm terminating resistor in the video jack field. Actually, during these initial stages no effort was made to expand the broadcasting schedule because of the wish to overcome first certain technical problems which are mentioned in a following section.

In due course, as might be expected, a request was received to record some programs that were to be delayed several weeks instead of for only two or three hours. Both *Godfrey* and *Bob Crosby* programs were involved — the former because of Godfrey's absence from the country and the latter because of pre-emption of regular studio facilities at broadcasting time by a *Shower of Stars* color program. This operation posed a small problem not present with time-zone delay operations.

It will be recalled that the prototype machines which are in use were not designed to permit the recording of a tape with one head assembly and playing it back with another. Thus, if between the time a recording was made and the time for its playback, the head were to wear out (or otherwise become unusable) all would be lost. The solution to the problem is simple, of course. One merely stores the head assembly used to make the recording together with the tape itself and hopes there are enough spare heads on hand to carry on one's regular operations until the captive head assembly can be released. This problem will disappear, of course, when production machines become available, since free interchangeability of tapes among machines is promised by the manufacturer.

At the present time (Summer 1957) a fairly heavy delayed-broadcasting schedule is being followed in order to cope with the Daylight Saving Time problem. Briefly, some 40 network programs are recorded weekly in Television City (Hollywood). All of these programs are played back at least once, some of them twice and others three times in order to accommodate the requirements of broadcasting stations in the Central Standard Time, the Central Daylight Saving Time and the Pacific Daylight Saving Time zones.

Because of the overlapping nature of the recording and playback schedule and the fact that all recordings are made and played back in duplicate, the available five VTR machines have to be supplemented with TVR facilities (for backup purposes only) during peak load conditions. The total number of VTR machine hours varies somewhat from week to week but is usually in the vicinity of (and has exceeded) 100 hours per week.

Presented on April 8, 1957, at the National Association of Radio and Television Broadcasters 35th Convention at Chicago, by Howard A. Chinn, CBS Television, 485 Madison Ave., New York 22.
(This paper received in final form July 17, 1957)

Fig. 1. A portion of the video tape recording and playback installation in CBS Television City, Hollywood.

Figure 1 shows a portion of the current VTR installation in TV City. Three of the five VTR machines now in use are seen in the photograph together with their supporting rack-mounted equipments. Figure 2 is a close-up view of one unit and shows an audio and intercommunications rack on the left, next, a rack which contains a waveform monitor, magnetic-head switching amplifiers, a modulator-demodulator chassis, a processing amplifier, and associated power supplies. The righthand rack contains a picture monitor, incoming video line and monitor switching circuits, frequency divider, drum motor oscillator, servo systems for capstan and drum motors, and their associated power amplifiers. In the background are three racks containing the audio and video terminal equipment for the entire setup.

The appearance of some of the queer results that can be obtained with improperly operating VTR equipment may also be of interest. Figure 3 shows the effect obtained when one of the four heads (or its associated amplifier channel) becomes defective. Since 16 television lines are recorded (or reproduced) for each sweep of a head across the tape and since the scanning lines are interlaced, a total of 32 lines as shown are affected when a head goes bad.

When the timing of the head switcher is incorrect, an effect such as shown in Fig. 4 is obtained. Here the switching between heads is not taking place during horizontal blanking and the switching transient may be seen on the left side of the picture.

If the pressure with which the heads ride against the tape is not properly adjusted, an effect such as shown in Fig. 5 is obtained.

Finally, when an attempt is made to play back a recording with a head other than the one with which it was made, an effect such as shown in Fig. 6 may be obtained. In this, as in the preceding examples, the discontinuities occur as 32-line intervals.

Before leaving the subject of video tape technical operations, special mention should be made of one of the many conveniences that VTR (or tape) affords

Fig. 2. A close-up of one video tape recording equipment group.

Fig. 3. Picture degradation cause by a head or its associated amplifier channel becoming defective.

Fig. 4. The transients along the left edge of this picture are caused by an incorrectly adjusted reproducing-head switcher.

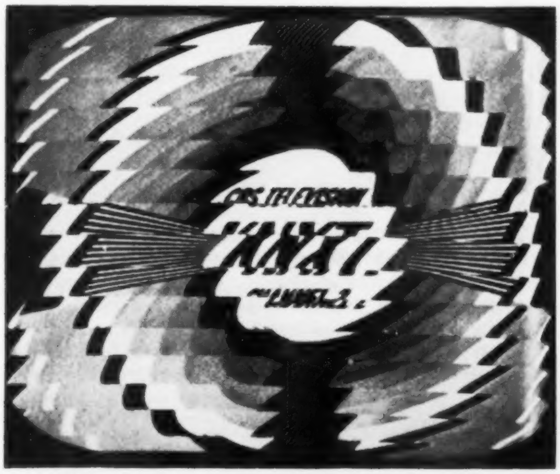


Fig. 5. If the head-to-tape pressure is improperly adjusted, an effect such as this can be obtained.

Fig. 6. The reproduction of a recording with a different head than used during recording can result in picture degradation as shown. Production video tape recorders will feature compatible heads.

Fig. 7. Signal dropouts caused by minute discontinuities of the magnetic tape surface degrade the picture as shown here for a particularly severe case.

over TVR (or film). If, upon reviewing a regular and backup video recording, it is found that one copy is unsatisfactory, a new backup can be obtained by a re-recording from the one good copy. Thus, assuming time permits, both a regular and a backup recording can be available for simultaneous playback by air time even though one of the original recordings may be defective. Similarly, where a recording and the head used to make it are stored for later use, only one recording and one head need be involved since, just before playback, a duplicate recording can be made for use at air time as the backup recording. These procedures are not new to those accustomed to handling magnetic sound recordings, but it is a feature not normally available when handling delayed television programs with "hot" TVR's because of the time element and potential degradation involved.

Video Recording Tape

The establishment of sources of supply for video tape has been a bit of a problem — to put it mildly. Since, from time to time, several superior samples of tape have been produced one naturally expects every square inch of all tape to be just as good as the best. It is a pleasure to report that the tape manufacturers are sympathetic to this slightly radical viewpoint and have been coating tapes at all hours of the day and night in an effort to reproduce, on a production basis, the very best samples ever turned out experimentally.

The three attributes of video tape which are of prime interest are: (a) the output signal level; (b) the absence of dropouts; and (c) the wearing properties. These subjects will be discussed in turn.

The need for adequate output signal level from the tape is obvious — it is required in order to obtain a satisfactory signal-to-noise ratio. At the same time, the amount of drive necessary to modulate the tape fully must be kept within reason. Finally, the "bandwidth" of the tape determines the maximum frequency deviation that can be employed for the FM modulation system that is used in present day VTR equipment. As is usually the case, in the final analysis one must choose between signal-to-noise ratio and bandwidth or resolution. Peak signal-to-rms-noise ratios of 38 db with 320-line (4 mc) resolution seem to be in the cards and there is every reason to expect improvement in this respect as time goes on.

Dropouts, or rather the elimination thereof, have been a very plagueing problem for the tape manufacturers. Dropouts are generally caused by pin holes, impurities, scratches or scuff marks in the magnetic coating. One of the most frequently asked questions is "What do dropouts look like in a TV picture?" When they are less than one line in duration, they simply look like ignition noise as shown in Fig. 7. Although the dropouts illustrated were actually considerably less than a full line in duration, in this particular photograph they are exaggerated in the vertical direction because of "blooming" of the picture tube and in the horizontal direction because of circuit transients.

The appearance of two kinds of dropouts on the surface of a tape is shown in Fig. 8. This illustration is a photomicrograph of a small portion of a video tape recording. The distance between centers of the video-modulated magnetic tracks shown is roughly $\frac{1}{64}$. Thus the area of tape shown in this illustration is about $\frac{7}{16}$ by $\frac{11}{16}$ in. Since the full width of the tape is 2 in. and 16 television lines are recorded on each of the tracks, a full television line is recorded in $\frac{1}{8}$ in. of track length. Thus in the $\frac{11}{16}$ in. of track length shown, there are recorded about $5\frac{1}{2}$ television lines. The video modulation is visible along each track.

The 240-cycle control track pulses that are recorded longitudinally on the tape are shown at the left of the illustration. Here, the effects of the individual laminations in the recording head are clearly visible.

Scuff marks, which can cause dropouts, are seen on the surface of the tape in the left portion of the illustration. A scratch is seen in the right portion of the photograph.

In Fig. 9, which is at a still larger magnification, the video modulation may be seen somewhat more clearly. In this instance, the area of tape shown is about $\frac{3}{32}$ by $\frac{5}{32}$ in. Most of the surface irregularities visible are merely loose dirt on the tape at the time the photomicrographs were made and are of little consequence. A minute scratch which can create a dropout may be seen, however, on the upper right side.

It shall be left to the tape manufacturers to tell, someday, the steps they had to take to meet video tape requirements. Meanwhile, it is obvious that they have had to undertake extreme steps in creating a practically sterile working atmosphere, to exert rigorous control every step of the way and to handle the tape with something a good deal better than kid gloves.

The third important characteristic of video tape is its wearing qualities. The tape for an hour's recording costs about \$300. If the tape is good for 100 recordings and 100 playbacks (or a total of 200 passes through the machine) the cost per hour is only \$3.00 (assuming one playback per recording). On the other hand, if the tape is only good for 10 recordings and 10 playbacks, then the hourly cost jumps to \$30 per hour. Tapes whose life ranged between these extremes have been encountered. Naturally, it is hoped that eventually the life of all tape will exceed the best obtained to date.

The life of the experimental tapes that have been made available has been a function of three basic characteristics of the tape — only one of which is usually controlling in a given roll of tape. Some tapes fail because of a soft coating that clogs the magnetic heads. Other tapes fail because of excessive scuffing of the tape. Finally, some tapes seem to have a coating that is so brittle that the recording heads chip off particles from the surface. However, there is every evidence that, by the time production video recorders are available, the tape manufacturers will have ample supplies of satisfactory video tape.

Engineering Design Problems

In common with just about every new piece of video equipment, when first introduced video tape recorders required considerable debugging. Among the problems encountered, all of which are now under control, were: (a) the question of head life; (b) a phenomenon called head-hunting; (c) head demagnetization; (d) the elimination of transients; and (e) the minimizing of dropouts in the reproduced picture.

The question of head life is an exceedingly important one since it can have a great influence upon the operating costs. For example, if a head lasts 150 hours and the cost of overhauling it comes to \$300, then its contribution to the overall operating cost amounts to \$2 per hour. But one hour of recording together with its playback amounts to 2 hours of head life, or a total of \$4. This is more than the tape cost which, on a 100-recording and 100-playback basis, comes to \$3 per hour. At the moment, the probable life of the recording heads cannot be forecast because, among other things, it will depend upon the nature of the surface of the magnetic tape that is finally adopted for video recording use. However, a 200 hour life does not seem too unrealistic.

Next, is the head-hunting problem. Everyone is familiar with the detrimental effects of turntable, sound-picture projector and magnetic sound reproducer wows. Since the magnetic head assembly in current VTR machines is a rotating device, it, too, is subject to wows or, what has come to be called, "head-hunting." The result of hunting of the head assembly is a lateral shifting back and forth of the reproduced picture which, in motion-picture parlance, is called "weave." Depending upon the nature of the horizontal synchronizing circuits in the receiver or picture monitor, the weave resulting from a given amount of head-hunting may or may not be severe. Obviously, in any commercial television application, one must anticipate the most unfavorable situation and correct for it. A servo amplifier with a high degree of feedback has now been made available and head-hunting is now practically nonexistent.

For some reason that has never been fully understood, nearly everyone concerned with television broadcasting (including engineers, operating personnel and program directors) becomes so captivated with the picture that they sometimes completely ignore the sound. Early in the game this led us (and others) into a neat trap. In the existing VTR machine the video information is recorded transversely or across the width of the tape while the soundtrack is located longitudinally along one edge. Thus, on playback, the video reproducing heads cut across the soundtrack at a 960-cycle rate. If the video heads take on sufficient permanent magnetization, they can record a 960-cycle buzz on top of the audio track. Because of a temporary failure of an automatic head demagnetization circuit, we managed to so modulate the soundtrack of a recording by the simple

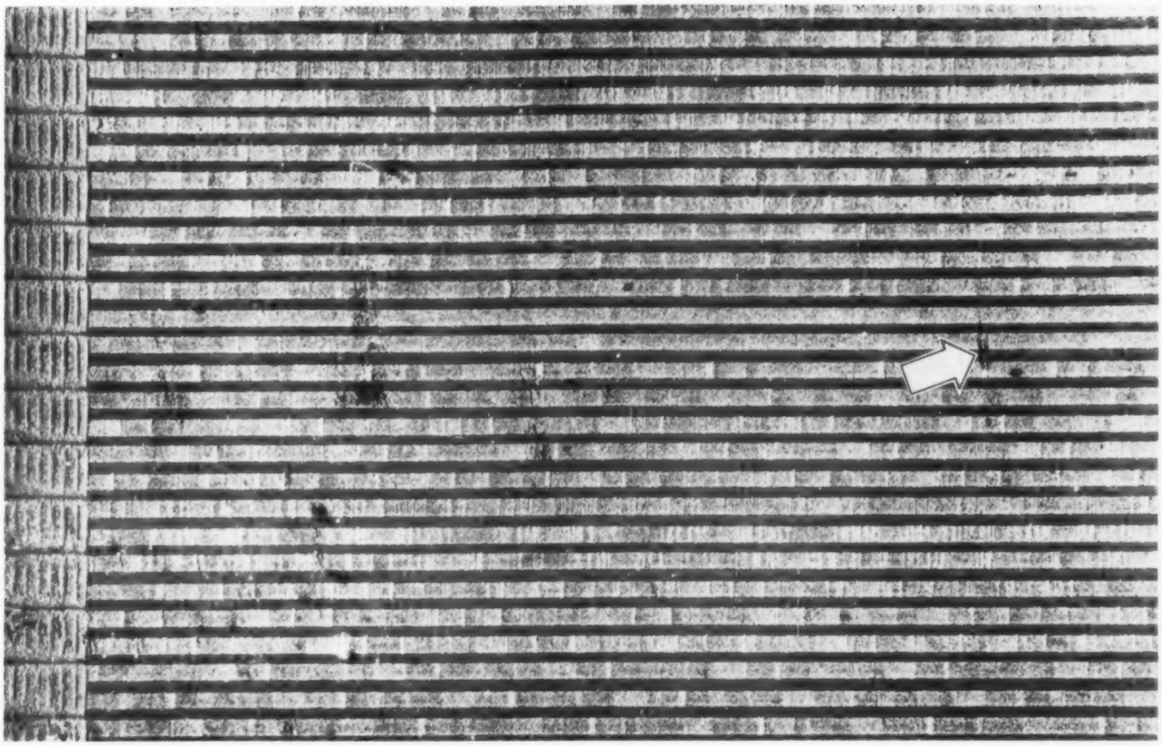


Fig. 8. Photomicrograph of a 7/16 by 11/16-in. area of video tape showing video and control tracks (which were magnetically developed) and magnetic surface irregularities. (Courtesy of Reeves Soundcraft)

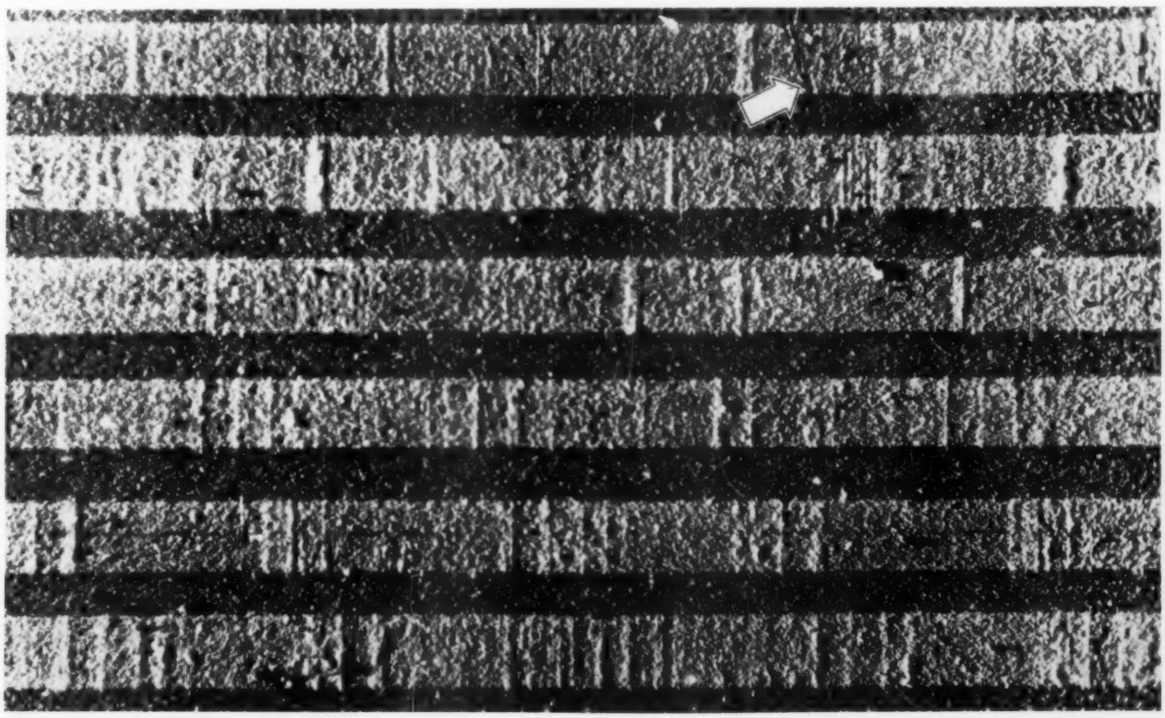


Fig. 9. Photomicrograph of a 3/32 by 5/32-in. inch area of video tape showing the modulation on the video tracks and a minute surface scratch. (Courtesy of Reeves Soundcraft)

process of not listening to the audio when reviewing the picture. The moral is plain — even video recording engineers cannot afford to ignore the audio portion of a program.

The existence of circuits that tend to create transients by ringing are probably more obnoxious in video tape recorders than elsewhere in a television system. This is because of their tendency to exaggerate dropouts as illustrated in Fig. 7. Here, instead of a dropout appearing as a short white streak, it oscillates back and forth alternately making white and black streaks. To minimize this phenomenon, the modulator-demodulator chassis originally supplied with the machine has been completely redesigned. The redesigned chassis has also resulted in better picture quality.

Other modifications that have been found beneficial include: (a) the development of a dropout minimizer circuit (dropouts now appear gray rather than white); (b) rearrangement of the top deck of the machine to permit the use of $1\frac{1}{2}$-hour reels rather than the 1-hour ones originally planned; (c) the installation of improved cascode preamplifiers to provide a better noise figure; and (d) modification of the recording amplifier output stage to permit higher modulation amplitude, and similar improvements.

Summary

To summarize, almost every week new specific applications for video tape are suggested and when more machines become available, it is anticipated that very widespread use of video tape recording will result. Its impact upon the television broadcasting industry will be even greater than was the introduction of sound magnetic tape on radio broadcasting — if one can remember back to the time when there was no audio tape recording.

The VTR installation made by CBS in Television City has been in regular daily service since November 1956, and although on occasion resort is made to a backup recording no program failures have been experienced to date. As a matter of fact, for the most part the picture quality is so good that even experienced observers have called to inquire whether a particular program was being broadcast "live" or reproduced from video tape.

The Economic Impact of the Audio-Visual Field

By JOHN FLORY

The audio-visual market has grown to the extent that over $1,500,000,000 has been spent for nontheatrical motion pictures and other audio-visual production, release prints, and equipment since World War II. The annual rate now exceeds $236,000,000. The rapid growth of this little-known facet of the motion-picture industry is of particular significance in view of the startling future growth predicted for the film as an informational medium.

No one knows exactly how many films a year are being turned out for the theaters, for TV programs, as kinescope recordings, for propaganda, for information, for education, for documentation, for instrumentation, for medicine, or for a host of other scientific, industrial and cultural purposes. At the moment, there is simply no way to catalog, to list, or even to count them.

Nonetheless, there is considerable evidence to support the contention that currently an average of nearly 77 new films is being produced in the United States every day. This includes both theatrical and nontheatrical pictures, as well as TV-program films and kinescope recordings. It does not, however, count TV film commercials or instrumentation or gunsight camera footage. A daily rate of 77 new films means an annual output of better than 28,000 per year (see Table I).

Hence, in less than seventy years since the introduction of the motion picture, and actually within the last thirty years, the film medium has come of age.

Presented on April 30, 1957, at the Society's Convention at Washington, D.C., by John Flory, Eastman Kodak Co., 343 State St., Rochester 4, N.Y.
(This paper was received on April 30, 1957.)

No consideration of the nontheatrical motion picture today can be complete without reference to related audio-visual tools and techniques. That is because the educational motion picture, in the parlance of the golf course, can be likened to the driver. A well-outfitted golf bag, however, contains a varying assortment of other types of clubs — each in its own way peculiarly adapted to a different type of shot. To pursue the analogy, some of the better-known clubs in the audio-visual golf bag are the sound filmstrip (or sound slidefilm, as business and industry call it), the 2 by 2-in. slide, the older $3\frac{1}{4}$ by 4-in. lantern slide, the overhead projector, the opaque projector, the tape recorder, the record player and so on and so on, right up to and including the television receiver.

Table I. Estimated Annual Film Output in U.S.A. (1956).

Entertainment films (features, shorts, newsreels)	1,000
Nontheatrical films	7,000
TV kinescope programs per year*	4,368
TV network $\frac{1}{2}$-hr shows originating on film*	4,264
Syndicated $\frac{1}{2}$-hr TV film shows*	11,680
Total "Films"	28,312

* For statistical purposes, each $\frac{1}{2}$-hr of kinescope-recorded material or original film programming is defined as a single "film." TV commercials, instrumentation footage, amateur cine, gun-sight camera footage, etc., have been excluded and are not part of these totals.

The above was demonstrated several years ago when O. H. Peterson, in charge of visual aids production for the Standard Oil Company of Indiana, regaled the members of the Industrial Audio-Visual Association at one of their meetings with a dramatic skit lasting forty-five minutes, in the course of which over sixty *different* audio-visual devices were employed.

While the nation's audio-visual production budget does not yet compare in yearly dollar volume to Hollywood's expenditure for entertainment motion-picture production, last year it equalled the film program production figure cited in the trade paper, *Variety*, for that new colossus, commercial television.

The replacement value of the 16mm sound motion-picture release prints owned by one Midwest university would be well over $1,000,000. Last year, a single motor-car manufacturer spent — for business motion pictures and other audio-visual aids — close to $6,000,000.

It is precisely because the use of film for informational purposes has become so ubiquitous in our society, that it is hard to measure statistically. To date, no private or government agency has assembled the particular figures which would give us an authoritative overall statistical profile of the audio-visual industry.

Table II. 1957—Business and Industry — (Predicted) Expenditures for Films and Other Audio-Visuals.

Film production	$66,000,000
Release prints	32,000,000
Distribution	23,000,000
16mm sound film projectors	12,000,000
Other audio-visual items	23,000,000
Total:	$156,000,000

Number of 16mm sound motion-picture projectors in the field of business and industry: 150,000.

Table III. 1957 — Government — (Predicted) Expenditures for Films and Audio-Visuals.

Film production	$11,000,000
Release prints	6,000,000
Distribution	3,000,000
16mm sound film projectors	4,000,000
Other audio-visual items	7,000,000
Total:	$31,000,000

Number of 16mm sound motion-picture projectors in the field of Government (Federal, State and Local): 62,000.

Table IV. 1957 — Education — (Est.) Ownership of 16mm Sound Motion-Picture Projectors.

Public elementary schools	96,000
Public secondary schools	48,000
Colleges and universities	7,000
Private and parochial schools	10,000*
Total:	161,000

* Note: For statistical purposes, parochial-school film projectors have been divided arbitrarily between above school item and church ownership as indicated in Table VI.

Table V. 1957 — Education — (Predicted) Expenditure for Films and Other Audio-Visuals.

Film productions	$3,000,000
Release prints	5,000,000
Distribution	2,000,000
16mm sound film projectors	6,000,000
Other audio-visual items	6,000,000
Total:	$22,000,000

Table VI. 1957 — Religion — (Predicted) Expenditures for Films and Other Audio-Visuals.

Film production	$3,300,000
Release prints	3,200,000
Distribution	1,800,000
16mm sound film projectors	3,500,000
Other audio-visual items	2,100,000
Total:	$13,900,000

Accordingly, somewhat in the spirit of a hobby, Thomas W. Hope, an associate of mine at the Eastman Kodak Company in Rochester, and I have lassoed every valid figure on the audio-visual field which we could run down, and after dint of considerable tablecloth arithmetic, have come up with the bits of statistical flotsam and jetsam exposed in this paper. Our computations and deductions are definitely not those of Kodak, but rather our personal conclusions, arrived at after hours and over weekends.

In lieu of authoritative statistics about the audio-visual field, therefore, and indeed in the hope that this paper will provoke them, the following thumbnail sketch is offered — in order to furnish the Society with some idea of the scope and nature of the market responsible for providing the daily bread of an increasingly large number of the Society's members.

As here defined, the United States audio-visual field does not include either the Hollywood entertainment film industry (except as 16mm release prints are exhibited in nontheatrical situations) or the commercial television field, which is using ever more film for programming purposes. Nor are we considering herewith the vast amateur cine market. Of over 3,000,000 camera users, some 85% use 8mm cine equipment.

Rather, we are attempting to describe the extent of the use which is being made of 16mm sound motion pictures and about half a dozen other important audio-visual aids, such as sound filmstrips, silent filmstrips, 2 by 2-in. slides, overhead transparencies, opaque projectors and tape recordings.

These audio-visuals are widely employed in the following areas, listed in relative order of dollar expenditures:

- Business and Industry,
- Government (Federal, State, Local),
- Education,
- Religion,
- Civic, Social Welfare and Recreational,
- Medicine and Health.

Business and Industry

From a dollar standpoint, by all odds the chief financial support for the audio-visual field in the United States comes from business and industry. There are a number of reasons for this, but basically, business has the need to communicate via graphic means, and the wherewithal to afford to do it.

Principal audiences for business films include:

- Stockholders,
- Employees,
- Dealers and Distributors,
- Customers and Prospects,
- Communities in which plants are located,
- Competitors and Trade Associations,
- Government Officials,
- The General Public.

On the basis of a list we have already compiled of 2700 corporate names, we estimate that there are probably in excess of 3500 companies and trade associations currently sponsoring one or more of their own 16mm motion pictures.

A study made several years ago by the Association of National Advertisers* of a significant sample of business films used for advertising and public-relations purposes indicated that nearly four out of five were shot in color. The average screen length tended to be about 25 min. Production costs varied all the way from $1,732 to a high of $426,600, with the median being $25,800. The median number of 16mm release prints was 100. The number of viewers reached by these films — principally through 16mm channels and not counting any additional viewership achieved over television — varied all the way from 40,040 to 21,852,465 spectators; with the median audience being 1,268,851. Adding together production, print and distribution expenses, the average cost to the sponsor of reaching each individual viewer with a 25-min message was 4.6 cents.

In 1957, it is now estimated that American business and industry own and operate at least 150,000 16mm sound motion-picture projectors. They are spending an estimated $12,000,000 for new film equipment, $32,000,000 for release prints, and $66,000,000 for new film and filmstrip productions. On top of these, is an item of $23,000,000 for distribution, plus possibly $23,000,000 more for other audio-visual materials and equipment. The total for this year, therefore, will add up to $156,000,000 (Table II). And that is estimated conservatively.

Government (Federal, State and Local)

Total estimates for annual governmental expenditures at the Federal, State and Local levels for films and other audio-visuals are difficult to arrive at, because of the multiplicity of political agencies at the local level and military security restrictions on information concerning a sizable portion of Federal spending. A conservative guess is what is shown in Table III.

Governmental agencies probably own upwards of 62,000 16mm sound motion-picture projectors, of which close to 60,000 are probably the property of the Federal Government.

Education

The largest number of 16mm sound film projectors is owned by educational institutions — public, parochial and private. The figure is estimated in Table IV.

In estimating the annual expenditures in the area of education, only those film productions are entered in this category which are nonsponsored, educational pictures (Table V); films, in other words, which either an educational institution has produced itself, or those on which a commercial producer has risked his own capital in the hope of regaining costs and a profit through the sale of release prints.

* *The Dollars and Sense of Business Films*, Films Committee, Association of National Advertisers, 155 E. 44 St., New York, 1954.

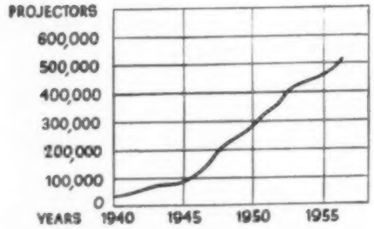


Fig. 1. Estimated number of U.S. 16mm sound projectors in use as of January 1957.

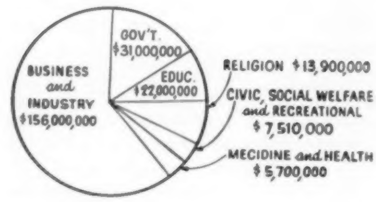


Fig. 2. Annual investment by the U.S. public in the audio-visual field; predicted for 1957 at $236,110,000.

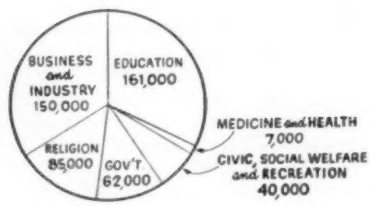


Fig. 3. Distribution of 16mm sound projectors in use in the U.S., an estimated total of 505,000 as of January 1957. ("Projectors" refers to 16mm sound motion-picture projectors in operation currently; approximately 45,000 additional projectors have not been included in this industry total because of obsolescence.)

Religion

Ownership of 16mm sound motion-picture projectors by churches, synagogues, and other religious institutions is estimated to be 85,000. Annual expenditures in the area of religion are given in Table VI.

An actual compilation of religious film titles produced during the forty-one-year period, 1915–1955, inclusive, reveals a total of at least 1573 productions expressly known to have been made for religious purposes. (Those general education films having by-product church use, as well as all television films and kinescope recordings of a religious nature, are excluded from the foregoing.)

During 1955, independent commercial religious-film producers were making two religious pictures for every one produced by a denominational source.

Civic, Social Welfare and Recreational

The broad category designated by the above heading encompasses numerous important groups. Principal among these are:

Farm,
Labor,
Boy and Girl Scouts,
Veterans' Groups,
Clubs and Fraternal,
Social Welfare,
Public Libraries,
Camps and Hotels,
Miscellaneous.

Taken together, these groups probably represent the ownership of about 40,000 16mm sound motion-picture projectors. Annual expenditures in this area are estimated in Table VII.

Medicine and Health

Under the general heading of Medicine and Health are lumped the other special disciplines of dentistry, nursing, veterinary science, hospitals, public-health agencies, and the like. Most original film and filmstrip production for this area is either paid for by governmental or pharmaceutical-company sponsorship. Since this is a more-or-less specialized and autonomous field of activity, medical film production is here enumerated (Table VIII) rather than under the headings of business and industry or of government.

The estimated total ownership of 7,000 16mm sound projectors for medical or health organizations may be divided thus: hospitals, 5,500; other, 1,500.

Summary

In summarizing, it should be explained that the most reliable single statistical base for extrapolating figures of audio-visual usage and expenditures (Tables IX and X) consists of data compiled by the U.S. Government concerning the number of 16mm sound projectors manufactured. Complete figures are available for the period of World War II. In 1954, the U.S. Census of Manufacturers contained basic data. Recent estimates of projector totals compiled by the National Association of Photographic Manufacturers, and expressed in terms of yearly percentages, have also been helpful (Figs. 1 and 3).

The aforementioned annual expenditure of $86,000,000 for nontheatrical film production is handled by approximately 3,000 separate and distinct motion-picture production units, varying in size all the way from the 500-employee studio of one of the largest business film producers, down to the single man, jack-of-all-trades type of motion-picture unit found, for example, in numerous factories and Veterans Administration hospitals. It is only fair to explain, however, that an estimated 550 motion-picture production units account for by far the greater bulk of the country's nontheatrical film output.

Over 3,600 different 16mm film libraries serve to distribute these films in the United States. Ownership of these libraries is vested in a wide range of establishments: commercial-film distributors and dealers, business and industrial firms, trade associations, school systems, universities, public (book) libraries, religious organizations, labor unions, governmental agencies, museums, fraternal and civic societies, and the like.

Table VII. 1957 — Civic, Social Welfare and Recreational — (Predicted) Expenditures for Films and Other Audio-Visuals.

Film production	$1,250,000
Release prints	1,100,000
Distribution	2,850,000
16mm sound film projectors	1,600,000
Other audio-visual items	710,000
Total:	$7,510,000

Table VIII. 1957 — Medicine and Health — (Predicted) Expenditures for Films and Other Audio-Visuals.

Film production	$2,150,000
Release prints	1,262,000
Distribution	1,225,000
16mm sound film projectors	800,000
Other audio-visual items	263,000
Total:	$5,700,000

Table IX. Estimated U.S. Audio-Visual Field.

Area of Activity	Projectors in Use as of Jan. 1957	Predicted 1957 Film and A-V Expenditures
Business and Industry	150,000	$156,000,000
Government	62,000	31,000,000
Education	161,000	22,000,000
Religion	85,000	13,900,000
Civic, Social Welfare and Recreational	40,000	7,510,000
Medicine and Health	7,000	5,700,000
Totals:	505,000	$236,110,000

Table X. Estimate for 1957 by Each Activity.

	Production	Prints	Distribution	Equipment	A-V Items
Business and Industry	$66,000,000	$22,000,000	$23,000,000	$12,000,000	$23,000,000
Government	11,000,000	6,000,000	3,000,000	4,000,000	7,000,000
Education	3,000,000	5,000,000	2,000,000	6,000,000	6,000,000
Religion	3,300,000	3,200,000	1,800,000	3,500,000	2,100,000
Civic, Social Welfare and Recreational	1,250,000	1,100,000	2,850,000	1,600,000	710,000
Medicine and Health	2,150,000	1,262,000	1,250,000	800,000	263,000
Totals:	$86,700,000	$38,562,000	$33,900,000	$27,900,000	$39,073,000

It has been stated* that there are, in the United States, over 1,000,000 groups — having fifty or more members each — which meet regularly, and are either actual or potential users of 16mm films as a part of their programs.

Back before World War II, the average sponsor of an informational film had to be prepared to furnish the services of an operator and a machine in order to get his film shown before one of these groups. Cost of such a procedure often ran between $17.50 and $25.00 per engagement.

Today, with a statistical average of one 16mm sound motion-picture projector for every 336 persons in the country, self-equipped audiences are relatively easy to find in every corner of the country, and in all economic walks of life. Sponsors of business films often budget $2.75, plus postage one way, as the cost of securing and servicing a 16mm booking. (In the case of nonsponsored films used by schools or churches, different cost schedules tend to prevail.)

* *See earlier footnote.*

With American business, education, and the churches becoming increasingly conscious of the need for much greater use of graphic communications, the estimated total of $1.5 billion invested by the American public to date in audio-visual equipment and materials is but a start. New devices, new tools, new techniques — many of them destined to be developed by members of the SMPTE — are inevitably going to result in a vast broadening of the field of film publishing.

Will the informational film of the future be a low-cost foolproof 8mm sound system? Or some as yet undescribed miracle of electronics? Or a combination?

Discussion

Joseph A. Schantz (Session Vice-Chairman): Would you care to give a look into the next ten years; do you think the growth and economic impact will continue to increase at as great a rate?

John Flory: I think we're about to experience a great upsurge. I wouldn't want to hazard any guess as to what we are talking about in the way of equipment, however.

Arthur Gould (Cine 937 Productions): Has there been any statistical work done on the [financial] returns, let's say, for an average subject in secondary school education?

Mr. Flory: I have not heard of anything that could be considered an authoritative paper on the financial results of the production of classroom films by commercial producers; however, in a recent article ["Developing an Integrated College Audio-Visual Program"], Prof. L. C. Larsen, Director of the Audio-Visual Center, Indiana University, describes production that they had been doing on campus. Proceeds from print sales go back into a revolving fund to be used for future productions. The material was published in the February 1957 issue of the *Phi Delta Kappan*.

Preparation and Presentation of Low-Cost Projectable Materials

By ALLAN FINSTAD

This paper introduces the subject with a historical treatment that relates the requirements for low-cost projectable materials to the evolution of the "overhead projector." It describes engineering efforts and design which have given this medium certain advantages of versatility. It further projects engineering goals for overcoming existing limitations. Low-cost projectable types are exemplified with reference to styles of presentation and methods of production.

In the nontheatrical field, or shall we say in the training and education field, visualized communication is moving toward general rather than specialized use. While special occasions may justify festive expenditures, it is at once obvious that the day-to-day usage of visual material in training and education can thrive only on a basis of the simplest of processes and the greatest economy in material costs.

As champions of low-cost projectable material, we face the discipline of a formidable competitor. We have but to step into any ordinary classroom to experience one of the oldest and most economical of all visual aids, albeit with its limitations, the blackboard; or, as it is known in educational parlance today, the chalkboard. To this historic medium we must admit certain outstanding advantages. It is conveniently mounted and stored. It provides an ever-ready surface on which to perform extemporaneously or in advance of presentation. The visual surface can be reused an innumerable number of times. It can best be used in a fully lighted room.

Presented on April 30, 1957, at the Society's Convention at Washington, D.C., by Allan Finstad, Visual Products Dept., Ozalid Div., General Analine & Film Corp., Johnson City, N.Y.
(This paper was received on April 9, 1957.)

Mention is here made of the chalkboard to establish a point of reference, or shall we say discipline. It will help us to understand the evolution of the requirement for low-cost projectables and the trend to the local preparation of them.

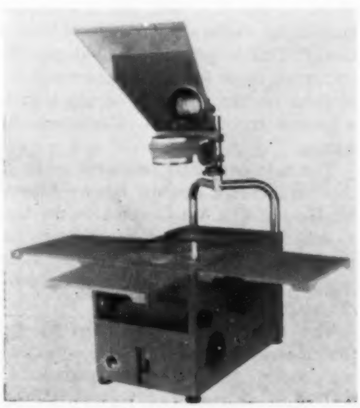


Fig. 1. Visual-Cast Video Scope, Courtesy Victorlite Industries.

Let us return to the chalkboard. It also has limitations. Image size is generally limited to the length of the "masters" arm. The instructor tends to face away from his class. Excessive time is required to replace one set of illustrations with another. Ready-made graphic material must be supplemented from other sources.

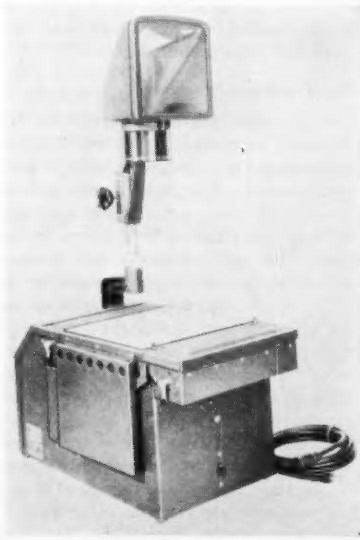


Fig. 2. Master Vu-Graph, Courtesy Charles Beseler Co.

Fig. 3. Transparency overlays projected at the front of a group, U.S. Army Photograph.

Fig. 4. Ozalid Ozamatic used in training aids shops to expose and develop Diazo Transparencies.

In the beginning, then, our teachers could have written a set of specifications for low-cost projectables by saying that they wanted their medium for visual presentation to:

be inexpensive;

permit us to extemporize in our instruction;

permit us to perform facing our classes;

provide us with large images for all to see; and

permit us to change scenes quickly.

Of course there was no such organized approach to the problem at that time. But the pertinency of the requirements must be granted. Now, to seek a design for projection that approaches the satisfaction of these requirements, we must turn to the consideration of the current "overhead" type of transparency projector. It is within the framework of this medium of projection that this paper has been prepared.

The Overhead Projector

In literature, prior to World War II, references were made to the use of a vertical transparency projector with a horizontal stage. The light source passed vertically through a horizontal aperture and then was reflected by a mirror to the screen. In other respects that projector had optical arrangements similar to lantern-slide projectors. In addition to projecting lantern slides, the "vertical" projector could be used, under room-darkening conditions, to project the effects of chemical reactions, crystal formations, etc.

During World War II, the air services procured a special vertical projector with a larger circular aperture and stage. This was used especially to project operable transparent navigation training aids. These projectors did not gain general attention or popularity, probably because of their low-intensity illumination. In the meantime, however, commercial versions with horizontal apertures up to 7 in. in diameter made their appearance. The Visual-Cast (Fig. 1) and the Vu-Graph (Fig. 2) are examples. Now, the use of the grease pencil on clear acetate, the application of transparent dyes to acetate, and other ideas already used in the preparation of handmade lantern slides, were talked about and explored. And the 7 by 7-in. horizontal stage provided more room for extemporaneous writing and sketching.

But the real impetus to the requirement for low-cost projectables for overhead projection came during the Korean conflict. With the emphasis on training, there was also a new interest in the local preparation of graphic training aids to teach the use of new equipment and weapons, and doctrine. Useful information and illustrations were found in bulletins and equipment manuals. It then became desirable to increase the size of the horizontal stage of the projector to 10 in. so that it would take a transparency equal to the size of "a page from a book." This larger stage would provide still more room for extemporaneous depictions on the stage. It would permit a greater concentration of light on the screen.

The first overhead projector to meet this requirement was the Beseler Master Vu-Graph. The Vu-Graph was the first to substitute the plastic Fresnel lens for the usual glass condenser, contributing happily to less weight and a greatly reduced production cost.

The magnification produced by the first Master Vu-Graph was approximately 5× at a projection distance of 6 ft. The magnification was about 10× at a distance of 12 ft. Thus, by expanding a 10-in. original transparency to a 9-ft image on the screen we had exceeded considerably the limitation of the usual chalkboard size. And at a distance of from 6 to 10 ft from the wall, we could operate satisfactorily from the front of the room and face the class while projecting. The light intensity was relatively high, permitting the use of the projector in a normally lighted room.

Projectable Materials for Overhead Projection

It is notable that the simple design of the overhead projector with its horizontal stage and aperture permits the use of a great variety of projectable-type materials. By virtue of the variety of projectables, this medium also affords diverse methods for the local preparation of the materials to be projected.

Materials that would be considered projectable from the stage of the overhead projector might include two-dimensional plastic objects like plastic rules and compasses; operable plastic mechanisms like computers and gear trains; and opaque cutouts or objects to serve as movable silhouettes. Transparencies may be prepared by hand with a wax pencil, they may be typewritten, or they may be colored with transparent dyes. Darkroom facilities may be used to prepare black-and-white film positives; or they can be produced in full color. Under room-light conditions, Ozalid-type print machines can be used to reproduce translucent originals to provide transparencies and overlays in a variety of analine colors (Fig. 3).

The Diazo Process for Making Transparencies

In industry the "diazo" process is used primarily for making "white prints" from engineering drawings on tracing paper.

As the larger overhead projector was being evolved, attention was drawn to the Ozalid transparent "foils" that were used for color proofing in lithography. These foils, which printed in analine colors, were found to be suitable for overhead

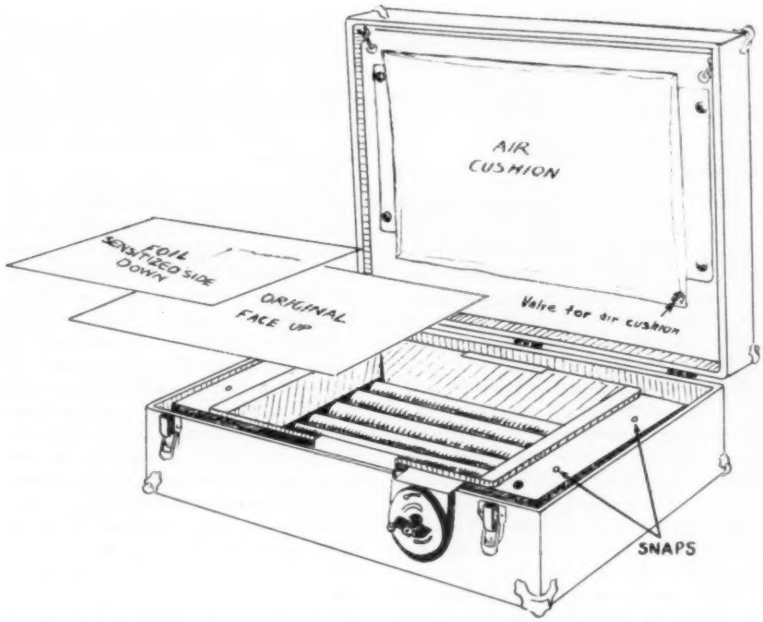


Fig. 5. Diazo coated film is exposed to ultraviolet light through a translucent or transparent original.

Fig. 6. Projecto Printer Kit combines the Diazo and photo reflex and transfer process, Courtesy Ozalid Div.

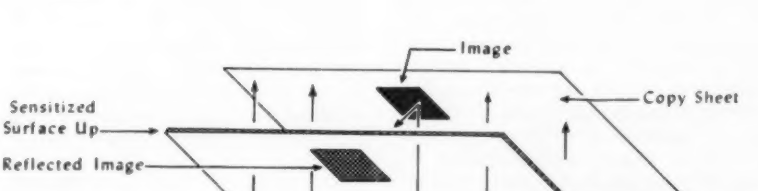


Fig. 7A. Reflex exposure for photo-transfer process.

projection. Consequently a number of Ozalid machines like the "Streamliner" and the "Ozamatic" (Fig. 4) and other makes and models were installed in the training-aids shops of the services to enable the preparation of transparencies on a semilocal basis. This ability to multiply transparency units under roomlight conditions further encouraged the acquisition of overhead projectors, which now are quite prevalent.

Let us briefly examine the diazo process. The chemical coating on the diazo film consists basically of two organic salts and a mild acid. The salts may be referred to as a diazo salt and a coupler. When the diazo and the coupler combine, an analine dye is formed. The acid condition of the coating prevents the two salts from combining prior to the printing process. Since it is the coupler in the coating that determines which analine color will result, the manufacturer selects the coupler that will be coated to provide the various colors offered on the market. Ammonia, a strong alkali, reacts with the coating to neutralize the acid, and this permits the combination of the salts to form the characteristic analine dye.

The diazo salt in the coating is sensitive to ultraviolet light. It will decompose when exposed to ultraviolet light, and is then rendered incapable of combining to form a dye. So if a sheet of film is left in the sunlight, so to speak, it would remain colorless in the presence of ammonia vapor. The process of making a diazo color print from a translucent or transparent original, therefore, is reduced to two simple steps.

First, the diazo-coated film is exposed to ultraviolet light *through* a transparent or translucent original master copy (Fig. 5). Only that portion of the film which coincides with the image of the original is now protected from the ultraviolet light. Then this exposed film is subjected to the action of ammonia vapor. The result is a positive-colored, analine-dye replica of the original image.

An oversimplified statement of the reaction follows:

UV Light + Diazo + Coupler + Ammonia *yields no color*

Diazo + Coupler + Ammonia *yields* Analine Dye

The process described is so convenient to handle that it can be demonstrated with a sunlamp for ultraviolet light and

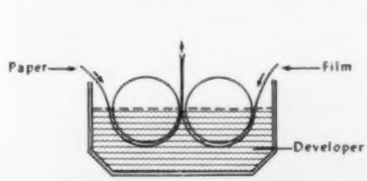


Fig. 7B. Exposed paper is developed negative and transfers to film as positive.

a pickle jar for an ammonia-vapor chamber. Because of its simplicity, this process has become very important in the effort to accomplish the preparation of transparencies on a completely decentralized basis.

When the diazo process is used, the original or master image must be on a translucent or transparent stock, that is, tracing paper, tracing cloth or on film. The master, therefore, must be prepared by drawing or copying on tracing paper, or it must be photographically processed on film.

Consider, now, the situation in which the desired original illustration is found on a sheet which is opaque to light, or printed on both sides; or it is in a manual or other bound copy from which it may not be removed. Recreating such an illustration by hand might be exceedingly time-consuming, or it might be beyond the skill of the instructor. Photographic cameras and darkroom facilities may not be available; or their use might also be beyond the experience of the instructor.

In a completely local situation, therefore, something further is needed to supplement the diazo–ammonia printing process. The simplest process possible is needed for rendering an opaque copy to transparent or translucent form. The character of this process will have to be nontechnical, and capable of positive results at the hands of personnel untrained in photography. A number of current office copying devices employ reflective exposure and transfer processes to make paper copies from opaque originals in typed or in printed form. Examples are: Verifax, Copease, Apeco, Contura-Constat, etc. Fortunately, the application of some of these processes to copying an opaque original on transparent acetate has been successful.

The Reflex Photographic and Transfer Process

Recently the Army Signal Corps procured the Ozalid Projecto-Printer Kit (Fig. 6). This kit consists of the components necessary to utilize the diazo process and the reflex photographic transfer process referred to above. The mechanics of the reflex transfer process are, briefly, as follows:

The exposure step is by reflection. Light passes through a negative photographic paper, strikes the original illustration and "reflects" to expose the sensitive side of the paper. The two are in close contact during the exposure, with the image side of the opaque copy in contact with the emulsion side of the sensitive paper (Fig. 7A).

The development step consists of processing the exposed paper through the chemical and bringing it into contact with a sensitized film, the two being pressed together between rollers as they emerge. The image which has developed "negative" on the paper now transfers to the film as a positive image (Fig. 7B). This can be observed visually. When the transfer is complete, the film is separated from the paper. The result is a positive black-and-white transparency.

Trends and Goals

The application of the industrial processes described in this paper exemplify an effort to meet the requirements of a trend in training and education. It is indicative of a trend among the users of projection equipment to exercise their own initiative, ingenuity and evaluations in their preparations for visual presentation.

There are yet, however, limitations in processes and equipments, which tend to limit the opportunity. For example, the overhead projector represents a bulk and an obstruction to good visibility unless the image is elevated on the screen. Elevating the image, however, produces a "keystone effect," a distortion of the image. The photochemical materials and solutions used are reactive to the ambient sunlight and to changes in temperature.

We may expect that the industries that are interested in the field of nontheatrical communication, will continue their efforts to extend this opportunity. Assuming that we now have an understanding of the progress made in this field in the past, we might indulge in idealism and suggest a few specifications for the future. As instructors we should like:

(1) **our medium of projection to**
be lighter in weight,
present less bulk,
minimize the distortions due to oblique projection; and

(2) **our processes for preparation of projectables to**
be less expensive,
be more stable against light and temperature variations,
eliminate the "wet" aspects in processing,
be capable of full-tone reproduction.

Slide-Projection Materials on Minimum Budgets

By HARVEY R. FRYE

There are four main areas of importance to the producer of slide-projection materials who must maintain a minimum budget. These are: mounting, lettering, coloring and photography. This paper presents a brief discussion of each of these four areas and offers suggestions on acquiring and using available materials.

In considering methods used in the production of low-budget visual materials it should be recognized that most visual materials are available from commercial producers; therefore, locally produced visuals should serve to clarify, supplement, simplify or emphasize points of special interest to the viewer.

A producer must have a knowledge of several techniques. A lack of knowledge in areas related to slide projection will limit flexibility and reduce the effectiveness of the final product.

For those who produce their own visual materials a picture file is extremely important. It supplies ideas, content information, drawings, color schemes, layout and lettering ideas and basic drawings that can be adapted to varied uses. Material for the file may be found in magazines, newspapers, catalogues and other sources. Copyright laws must, of course, be taken into consideration; but many organizations produce excellent non-copyrighted material that can be used in many ways. This material may be purchased in sheet or book form at relatively low cost and is a great aid to those who find drawing too difficult or too time consuming.

Another commercially available product is the tape, obtainable in wide variety used to make straight lines, dotted lines, cross hatch and repeated symbols in many colors and widths. These are available on opaque- or transparent-based materials.

A study of visual materials in general shows that there are four main areas of importance in the production process: (1) mounting, (2) lettering, (3) coloring and (4) a knowledge of photography or related processes so that the producer will be able to enlarge, convert or manipulate his material so as to add flexibility in both transparent and opaque form.

Mounting

Mounting is important in the preparation of paste-up artwork to be copied and transformed into transparencies. There are a great many different mounting materials. One widely used method is that of dry mounting. In this procedure a sheet of dry adhesive tissue is placed between the picture and the mounting board. When heat is applied, the adhesive melts, fixing the picture to the backing. This makes a clean, permanent mounting. An electric flat-iron may be used to apply the heat, but there is special equipment now on the market which it is advisable to use.

Another common method of mounting requires the use of rubber cement. Rubber cement is not as permanent as dry mounting and may be affected by temperature rises, but it has certain advantages. It is sufficiently transparent so that if carefully applied it can be used to stick acetate surfaces together for temporary projection purposes.

Another use for rubber cement is that of transferring the image from the printed page to a sheet of acetate. In this process the ink from a printed page is taken off the paper and affixed to a transparent acetate surface so that it can be projected. This will work only with pictures printed on clay-base paper. In using this method, the face side of the picture is coated with a thin layer of rubber cement and a piece of frosted acetate is coated in the same manner. When both surfaces are dry they are pressed together and then placed into a pan of cold water which contains a little detergent. It is allowed to soak 5 to 10 min until the water has penetrated the paper (Fig. 1). The paper is then peeled off and the image adheres to the rubber cement which in turn adheres to the acetate surface. The excess clay is then washed off and the resulting translucency allowed to dry. The rubber cement surface is then sprayed with liquid plastic to protect it and give it greater transparency. After it has dried, it may be bound between glass or plastic for further protection. Slides made by this process should not be used in a size smaller than $3\frac{1}{4}$ by 4-in. because of the magnification of flaws in printing and the enlargement of the halftone dots. There is a definite limitation on the size of the material which may be used.

Rubber cement may be used in two ways when doing regular mounting—temporary or permanent. When mounting by the temporary method the surfaces should be placed together while the rubber cement is still wet, and in permanent mounting the surfaces should be placed together after the rubber cement has dried.

Lettering

Lettering is extremely important to persons producing their own visual materials. Today there are hundreds of lettering aids which may be roughly grouped into six categories—rubber stamp, cutout, stencil, stencil with special pens, mechanical systems and paste-up.

The rubber stamp (Fig. 2) is one of the least expensive aids and requires a minimum of experience to use effectively. Rubber stamps may be purchased in a

Fig. 1. When the clay-base paper is peeled away from the rubber cement, the image remains on the cement surface.

Fig. 2. Inexpensive rubber stamps may be used on original artwork and in some instances on handmade slides.

Fig. 3. Cutout letters.

Presented on April 30, 1957, at the Society's Convention at Washington, D.C., by Allan Finstad for the author, Harvey R. Frye, Indiana University, 901 N. Indiana Ave., Bloomington, Ind.
(This paper was received on March 8, 1957.)

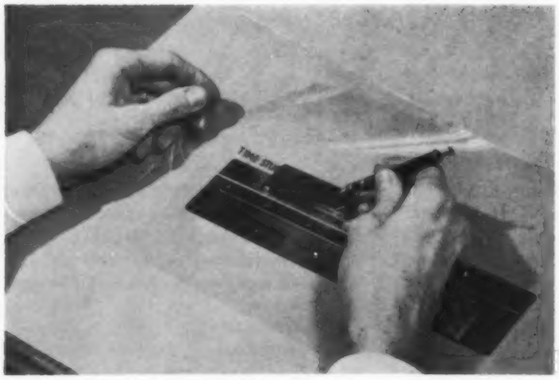


Fig. 4. Lettering on acetate with special pens and pencils.

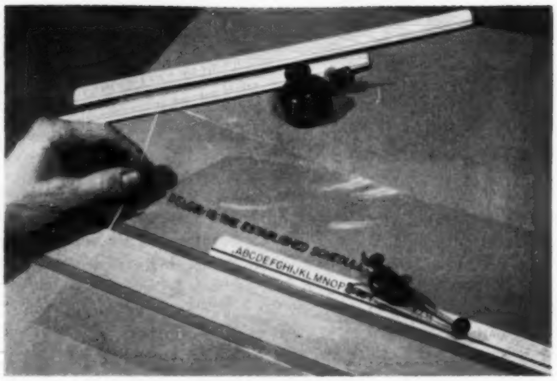


Fig. 5. Mechanical lettering devices are versatile and precise.

variety of sizes but in a limited number of styles. The most common use for rubber stamp letters is on original artwork which is to be copied for slides. Where quality is not too important, some rubber stamp printing can be done directly on handmade slides using special inks. When the slide is projected, magnification of small defects in printing will be emphasized. Rubber stamps may be used with various colors of ink and if printed on translucent paper, the paper may serve as a master from which transparencies may be made by the diazo process.

The cutout letter (Fig. 3) is probably best known through the 3-dimensional tile letters purchasable in almost any photographic shop. These letters are also made of plastic, metal, wood, paper, cork and other materials. The cutout letter, as well as the rubber stamp letter, tends to favor the bolder letter styles and has certain limitations. It is favored by many producers, however, because the letters can be glued or pinned to artwork and copied directly by the camera. If care is taken in aligning the letters they will give a consistently pleasing effect.

Cutout letters backed with flock will adhere to flannel boards. In making quick titles or simple graphs or charts, setting up lettering on a flannel board and copying it in black-and-white or in color may be one of the fastest and most economical ways of producing slides.

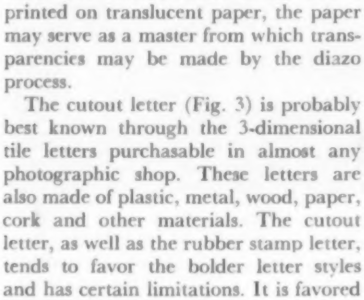


Fig. 6. Paste-up letters used in line artwork.

Some plastic cutout letters now being produced will adhere to any slick surface. Letters of this type placed on glass may be laid over artwork or may be held in front of a live scene so that the caption is directly on the original transparency. The smaller-size cutout letters (which are relatively large for transparencies) may be fastened temporarily onto the larger transparencies such as those used for the overhead where the use of fairly large lettering is permissible. These letters may also be used in making vari-colored diazo transparencies by affixing the letters to a transparent surface to form the master. Such a master may be used to contact print on film, although the resulting product will usually be in the negative. It can, however, easily be reversed to form a positive transparency.

The third category of lettering is the old-fashioned stencil. Closely allied to the stencil is a method of tracing letters by the use of pens in cutout plastic stencils (Fig. 4). A variety of sizes is available but styles are limited; however, this system has a neat, bold, easily read letter and the styles that do exist generally reproduce well on slides. The size range is so wide that if bold lettering on $3\frac{1}{4}$ by 4-in. slides is desired it can be accomplished by the use of this lettering system. For lettering directly on slides, there are commercially available special plastic inks which adhere well to acetate surfaces. However, it is advisable when making handmade slides to use regular drawing ink on a specially surfaced plastic which is available in most art stores. If errors are made they can easily be rubbed off with a damp piece of cotton.

The fifth type of lettering is referred to as the mechanical method and, although more expensive than the other types, is extremely versatile. This method requires a template (on which is engraved the letters of the alphabet) together with a scriber and a pen which traces the alphabet off the template onto the plastic surface (Fig. 5). Specially surfaced plastics and inks can be used in the same manner for handmade slides. The characteristic of the engraved template permits a variety of lettering from a fine script to a heavy block letter. In some cases adjustable scribers will permit variations of the original letter on the template. Extremely small sizes permit lettering on $3\frac{1}{4}$ by 4-in. slides. These lettering devices are quite precise. When preparing artwork to be copies for slides they make possible an extremely clean, fine letter which reproduces well on the resulting transparency.

A sixth widely used type of letter is the paste-up (Fig. 6). The letters are usually printed on sheets of paper or in small tablets. The letter is pulled from the tablet or cut from the printed page and fixed to the artwork with adhesive. Various methods may be used to insure proper alignment such as specially made setting sticks or alignment lines on each letter. The letters are usually printed on lightweight, good-quality white paper or card. They may be obtained in a wide variety of styles and sizes which gives a wide choice in spacing and design. This method of lettering is most successful when used in conjunction with line artwork. When used with continuous tone copy, the edges of the paste-up become quite evident and the result is undesirable; however, when high-contrast film is used in copying paste-up lettering, evidence of the pasted-up edges is lost. If some of the paste-up edges of this type should show in the negative they can easily be painted out.

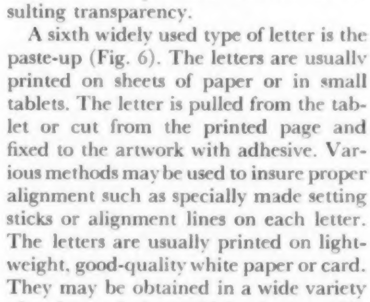


Fig. 7. Slide crayons used to color handmade slides.

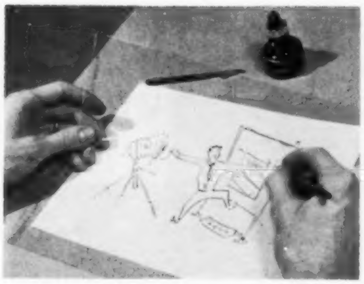


Fig. 8. Drawing inks used on specially surfaced plastics.

Fig. 9. Photographic negative tinted with transparent water color.

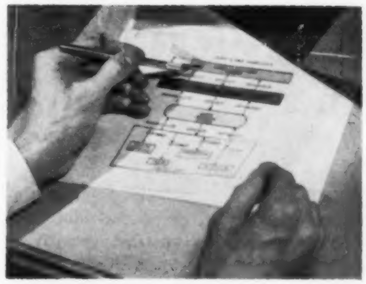


Fig. 10. Colored adhesives cut to fit area.

In a variation of this type of lettering, the letters are printed on a clear acetate base coated with adhesive. The letters may be cut from sheets and stuck directly onto photographs or artwork. These acetate-based letters may be fixed to a glass or heavier plastic sheet to serve as a master for reproduction on high-contrast photographic film or on diazo films used in the reproduction of slides.

Coloring

There is a great variety of methods, but chiefly four categories are most widely used for coloring: colored slide crayons or pencils; transparent and opaque drawing inks; transparent water colors, and colored adhesives.

Slide crayons (Fig. 7) have been used for years in the production of slides for the $3\frac{1}{4}$ by 4-in. projector. When the slide crayon is drawn on an etched or frosted glass or plastic surface, it leaves a transparent image and neatly shaded drawings in beautiful color can be made. Water soluble transparent pencils may be used for the same purpose. This method requires some artistic ability on the part of the producer. One disadvantage of this method of slide-making is that the work must be done on an etched surface; therefore, the resulting slide is actually a translucency rather than a transparency and will lose some of its brilliance when projected on the screen. This form of slide needs a strong initial light source and good room darkening facilities. It is possible to increase or to bring about almost complete transparency by spraying the completed slide on the etched side with a heavy coat of liquid plastic. This is obtainable from most automotive supply, hardware and paint stores.

The plastic fills in the rough etched surface of the slide, making a smooth, slick surface. The range of colors obtainable by the use of this method is almost endless. Several basic colors of crayons are part of the initial set. By shading one color over the other almost any shade or tint may be obtained.

Drawing inks may be had in two forms — opaque, which projects as a black on the screen; and transparent, which projects in color on the screen when light passes through it.

It has been common practice to coat the surface of the slide with a clear gelatin because of the difficulty of making a smooth drawing in ink on glass or acetate. This practice is no longer necessary. Art stores today sell a treated acetate which will accept ink, permitting extremely fine line work on its surface (Fig. 8). It will withstand the heat of the projector and errors can be wiped off with a piece of damp cotton.

Transparent water-color is used to make drawings which may be copied on color film and it can also be used to tint black-and-white slides (Fig. 9). Actually the process of tinting slides with water-color is quite old. Many of the first color slides were hand-tinted black-and-white glass slides. The process is quite simple. A regular black-and-white continuous tone or high-contrast slide is made and washes of color are spread over the emulsion side of the film where the color is desired. It is easier to color high-contrast slides in the negative form, because the image will appear clear with a black opaque surrounding.

Tinting this type of slide can be accomplished by dipping a ball of cotton on the end of a toothpick into the color and rubbing it over the transparent areas where color is desired. Any color rubbed onto the black surrounding area will not show. This is the least expensive and fastest method of tinting slides. Water color may also be used on the specially surfaced plastic described above. When fine detail is to be tinted rubber cement may be painted on the slides to mask areas on which color is not desired.

Colored adhesive (Fig. 10) is a lightweight, transparent, colored acetate sheet with an adhesive backing which will adhere to almost any surface. The longer it remains on a surface, the more firm it becomes. It is not affected by heat and will withstand a certain amount of rough handling. Colored adhesive may be used on handmade or photographic slides as well as on opaque materials. Other colors can be made by placing various textures and colors in combination. Color may be removed from the surface of the colored adhesive by carefully erasing or scratching off small areas. When fitting colored adhesive to large areas, it is cut to fit the shape by using a sharp frisket knife or razor blade. This is one of the easiest ways of achieving smooth, colorful areas; however, the cost is somewhat higher than for the other methods described.

Photography

There are many different ways to use photography in the production of slides. One method makes use of high-contrast film. This film was originally designed for use in graphic arts, primarily for copying high-contrast or line copy. For those who are not able to do direct artwork and must paste up original copy, it is a valuable aid. This film has a tough emulsion which permits rough handling and variations in temperature and is resistant to abrasions when used for projection. When it is desirable to manipulate the content of a slide, the film may be cut up and rearranged by sticking it back together with tape, providing the tape is used only in the opaque areas of the film, and the film can be used in either the negative or positive form. This film may be purchased in sizes from 4 by 5-in. to extremely large sizes, permitting the making of transparencies in almost any size and allowing flexibility in the size of projected material.

The producer who is beginning to explore the possibilities of making low-cost slide materials will find that the continual development of new methods and new materials will offer endless opportunities to exercise his ingenuity and selectivity.

A Method of Producing Charts and Graphs on Film

By ARTHUR L. LAUFMAN

This paper describes a method of producing charts and graphs on film. The process depicts progressive growth of such graphs and the possibility of their use for superimposition on live-action scenes.

Animation can be accomplished with a limited amount of simple equipment, the cost is low, and the supplies can be found in any standard motion-picture studio.

The use for animation is required now more than ever for technical films. Animation lines superimposed on technical films have been in use at this laboratory for several years. The audience can visualize the action of the event along with the pertinent data at the same time.

The equipment used for animation at this laboratory consists of: cardboard; stapler; synchronous motor 115-v a-c, 60-cycle, 10-rpm, 9-w torque 12 oz-in.; thin piano wire; black-and-white enameled, coated paper stock.

The object is to show on the release print a plotted curve superimposed on the screen showing action of a crashing airplane, with deceleration graphs. Thus, the picture and data records are shown simultaneously (Fig. 1).

The first step is to have a contrast print of the plotted curve (the lines jet black, background pure white). This print is to be dry mounted on a heavy cardboard. A cardboard track is stapled on 3 or 4 in. away from both top and bottom of the picture area. In this track, a thinner cardboard is made to fit loosely. The size is twice the length of the original picture area (Figs. 2 and 3).

Now, there is a plotted curve of the scene to be photographed, mounted on a cardboard with another cardboard that slides over this picture area. The sliding cardboard has the enameled, coated, paper dry mounted on it, the right half black, and the left half white. Stapled to the black half is a piece of cardboard, making an extension with a hole in it to attach the piano wire. The wire is then attached to the designated pulley wheel on the synchronous motor. The half-white and half-black cardboard is mounted in such a way that the horizontal line (abscissa) is not covered with the black

A contribution submitted on April 20, 1957, by Arthur L. Laufman, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, 21000 Brookpark Rd., Cleveland 11, Ohio.

Fig. 1. Developed film. Film strip of cartwheel crash of FH-1 fighter airplane, with superimposed decelerations graphs. Top curve, longitudinal decelerations; middle curve, vertical; bottom curve, lateral deceleration.

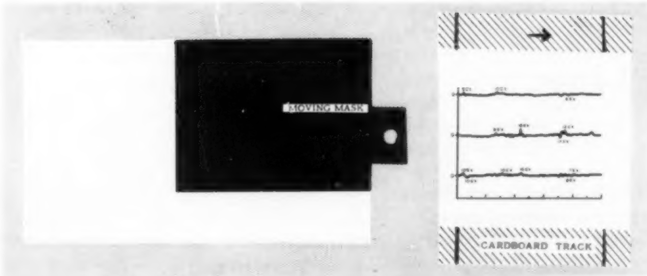


Fig. 2. In this explosion view, moving mask is shown alongside permanent cardboard with line drawing mounted on cardboard with cardboard tracks stapled on.

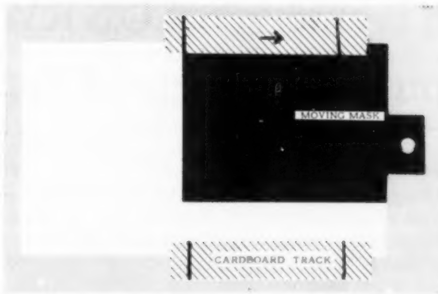


Fig. 3. Assembly of mount ready to be used.

paper. The area below the abscissa line should be white.

When ready to photograph this effect, the sliding card is put into the track and lined up with the vertical line (ordinate) by having the dividing line between the black and white lined up correctly for the shooting of this scene.

The wire is connected to the synchronous motor and high-contrast positive film is run in the camera; then processed in D-16 Developer. The processed film is now a printing mask for one more printing step (Fig. 4A). Take out the sliding cardboard and photograph the plotted curve. Rewind this footage and use masking film previously made with the emulsion in the same direction as the printing stock, print and then develop (Fig. 4B).

There is now an animation roll (Fig. 4C) and it can be incorporated in an A & B printing system to produce the final product. This animation can be superimposed on picture or color background, as desired. With slight modification, other methods can be devised with straight lines and circles, printing either black-and-white or color. Simple animation lines or simple wipes can be used with this method.

The equipment cost for this simple animation method is $20.00 to $25.00, the synchronous motor being the costliest portion. The other material is standard equipment used in the studio for other purposes.

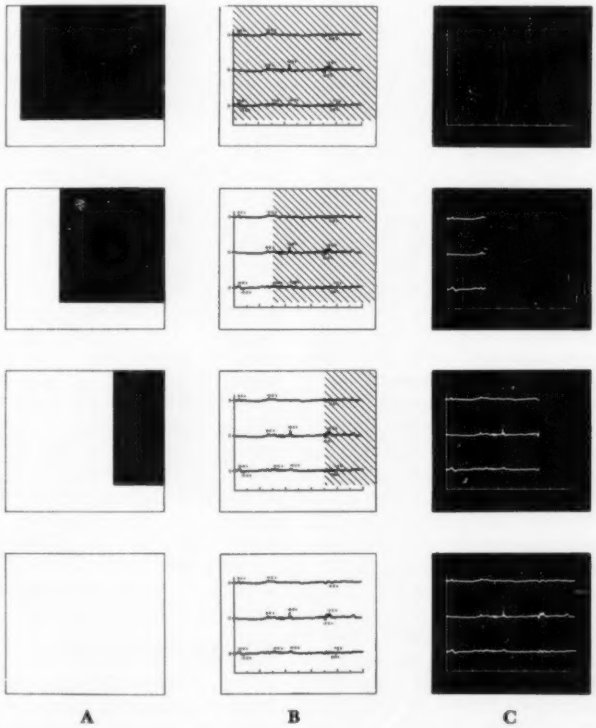


Fig. 4. A, movement from top down showing matte action in printer; B, virtual image on film after matte has been printed; and C, final developed film with matte and picture combined.

The Unesco–UNRWA Pilot Project on Low-Budget Film Making

By NORMAN SPURR

This paper describes an experiment, conducted in the Middle East by Unesco in close cooperation with UNRWA, in low-budget film making for educational purposes. This report is designed to be of interest to all those concerned with the use of films in fundamental education.

To meet the stringent budget requirements demanded in film making for fundamental educational purposes in areas of illiteracy, we resorted generally to the use of 16mm film, very small production teams, in some cases one-man units, and the production of silent film to which commentaries were added over a public-address system. But the cost of photographic soundtracks remained high, especially when used in a multilingual society, so that it was uneconomic to produce such tracks. The arrival of ferromagnetic materials as a means of recording sound made it possible to replace the "live" commentator with a tape commentary, or musical background and nonsynchronous sound effects. This system worked well at a low cost, but there was always the hazard of lack of adequate synchronism between the projector and tape. When ferromagnetic materials were coated with a thin stripe on the film itself, it became possible to locate the sound accurately and permanently against the appropriate visual image.

The practical application of new techniques to the problem of producing visual media for the service of fundamental education has always been of interest to Unesco. In 1952, they loaned the Tanganyika Government a 16mm Bell & Howell magnetic/optical sound projector in order to promote field tests in the use of magnetically striped film. During these tests, successful trials were conducted which made possible the recording of synchronous speech using a tape recorder as the primary recording medium and transferring the sound from tape to stripe. The problem of speed adjustment on playback between recorder and projector was overcome by using a variable-output transformer in the mains lead of the tape recorder, and although the method was somewhat crude, effective and cheap synchronized sound was obtained. Today, pilot-tone and synchropulse techniques have eliminated the crudeness, but have, naturally, increased the cost.

The use of striped film stock solved the problem of producing cheap sound-on-film where only two or three copies of a film were required, but it did not solve the problem of processing. This has always been one of the great drawbacks in producing films for fundamental education in areas remote from established centers of film production, for all films have to be sent outside the area for developing and printing, and this means delay. In fact, in working with a very tight shooting schedule, several productions might have their photography completed before a single work print came back from the laboratory. In normal circumstances, this might not be disastrous, but it provides a very serious obstacle in the production of such material as newsreels. The problem was concerned with two matters, the visual image and sound. The setting up of a processing plant would solve the difficulty of getting picture material quickly, but if the positive copy had to be sent away to be striped, there was only a small saving in time. On the other hand, if striped unexposed positive film stock could be printed and then put through the developing solutions without detriment to the stripe or to the solutions, then a unit might be truly self-contained.

Objectives of the Project

The Unesco-UNRWA Pilot Film Project was designed to test the possibilities of the use of such striped materials as a low-cost method of producing educational films on the spot. It was also designed to test whether the ability to produce material quickly was as important to the film medium as it is to television, and so the technical means had to serve practical ends, in this case, the production of a newsreel or magazine for the Palestine refugee camps. The project was to have been sited in Gaza, but as this became impractical, it was finally launched in Jordan in three rooms on the top floor of UNRWA's Headquarters building, Amman, where both water and electricity were available.

If the Pilot Project were to serve useful ends as a technical contribution to the production of visual material, it was necessary to bear in mind the practical matter of cost not only in terms of capital outlay, but with regard to the recurrent charges as well. No equipment was ordered that was not available on the open market, and operating staff was kept to an absolute minimum — a team of two. One was an Arab, recruited locally, who acted as liaison officer and trainee, while the other had technical experience in all branches of film making and was expert in the practical field of making films for education. This decision was possible only because ferromagnetic materials were available for sound recording and so the rigid standards for the production of good photographic sound were avoided.

Film and Taking Equipment

All film used in the experiment was 16mm stock. The single-perforated, fine-grain, unexposed positive stock, Ilford 5YBW, was delivered with a full stripe coated on the celluloid side. A further quantity of the same stock and same batch number was supplied unstriped in order to save striping costs for the work print. HP3, FP3 and Pan F were the negative materials used in the camera.

The camera was a 16mm Arriflex fitted with 400-ft magazines, sunshade and filter holder, and a Pola-Screen for making fades and dissolves in the camera. An important factor was the motor drive which held film speeds at a high level of constancy.

The tape recorder, a Reflectograph, was chosen for two important features. One was the ability to change the speed of the tape continuously from 3.75 in./sec to 8.5 in./sec by means of a mechanical control. This enabled the tape to be played back at the same speed used during recording irrespective of voltage and frequency changes between record and playback. The second feature was the synchronizing frequency injection control. By pressing a button, a short recording of a synchronizing frequency is made on the tape before an actual recording. The 50-cycle mains frequency is the one normally used for the purpose. This frequency can be made to "beat" back at the commencement of replay, the record level meter acting during this function as the error signal indicator; by this means a very accurate record-to-playback speed accuracy can be obtained of about 0.1%. The capstan motor is of the synchronous induction type and less susceptible to frequency changes than to voltage changes, an advantage when recordings are made in the field with power supplied from a

A contribution submitted on May 18, 1957, by Norman Spurr, United Nations Educational, Scientific and Cultural Organization, 19, Avenue Kleber, Paris XVI, France.

motor generator or car battery and are to be played off the mains.

For location work, a vibrator-type power-supply unit was used to give the required a-c supply from a 12-v d-c source, and it was claimed for the unit that it was at least 80% efficient at wattages over 50, and its frequency control was within 1%.

The final link in the recording chain was a British Thomson-Houston Type 401 magneto/optical 16mm projector. Its unit construction made it easy to service and it had a control of wow and flutter which suggested that it could be used successfully for re-recording from one machine to another. At the time of purchase, the manufacturers were working on a mechanical link to enable two 451's to be run in synchronism for this very purpose.

Developing Equipment

The developing plant came from Holland. It was of the continuous type with the usual wet and dry sections. The dry section was fitted with a thermostatically controlled heating and cooling spiral, and the air circulated under positive pressure and entered the machine through a simple type of air-cleaner; a hygrometer and thermometer were part of the standard equipment. The wet side started with the developing tank, followed by a wash tank, fixer, and four separate wash tanks, the last of which was fitted with a siphon system for emptying the tank. This tank was also fitted with a drip-feed to allow the addition of a wetting agent to the water in the correct proportion. The capacity of the developing tank was 17½ liters and it was fitted with a circulating pump and an immersion heater for raising the temperature of the solution. Since the machine was used for negative and positive development, extra storage tanks were purchased into which the solutions from the machine were pumped and from which they flowed by gravity. All piping was plastic and as no cocks were fitted, control of the direction of flow of the various liquids was by means of rubber stoppers.

The motor driving the developing machine ran at two different speeds, and by changing the drive sprocket, two additional speeds were available. The machine could take either 35mm or 16mm film, and developing times could be altered by raising or lowering the first loop of film in the developing tank.

Development Controls

Time and temperature methods of development were used, and in order to have some control over development time a series of tests was conducted to find out the relationship between a length of film in the bath and the development times at the four different speeds. These times were calibrated against the number of revolutions which had to be made by the drive sprocket roller to bring the bottom rollers to any predetermined position between top and bottom. To enable the development time to be altered in the dark, a nick was cut in the drive roller which could be felt by the finger as the roller revolved.

In order to keep the results of development up to a reasonable standard without the use of sensitometric methods and chemical analyses, the simplest of replenisher techniques was used whereby the amount of lost developer was replaced by an equivalent amount of replenisher for the type of developer in use. These were I.D.11 for negative stock, and I.D.19 for positive stock. They were bought already packed, ready for use, together with their replenishers. I.F.22 was used for fixation. These methods proved quite suitable in practice although frothing was once experienced with a developer which has proved quite trustworthy for several hundreds of feet of film. Negatives emerged from the dryer in good condition and remarkably clean. As the staff felt too inexperienced to join film to the leader while the machine was running, all footages were first joined to a tail leader which served to maintain threading after the developed film had passed through the solutions. The whole film was then joined to the machine leader when the machine was at rest.

The films were printed on a continuous contact-type printer, and although a step-by-step printer would have been preferable since there was no need to print photographic sound, there was no time available to search for one at a price the project could afford. The Micop printer is modestly priced and measures 2 ft 6 in. long by 1 ft 10 in. deep by 10 in. wide. With it can be bought an automatic light changer with which ten consecutive light changes can be preset before further resetting is required, which gives plenty of time to change No. 1 light before the last one in the sequence has operated. A notch is cut in the film to trip the change mechanism and exposure can be adjusted by altering the width of the exposing slit as well as by a variable resistance in the lamp circuit. A persistent trouble was the failure of the notch to trip the light changes, a failure we attributed to the primitive method of making the notches in the film.

The grading of a negative for printing can not be learned in a few days and as a Cinex timer was not part of the equipment, another method was employed. As each negative was examined after processing, a clipping was taken from each scene. These were joined together on one roll and listed with reference to the original scene from which each was taken. This roll was then printed, using a range of light changes to suit the printing requirements, then developed and the scenes matched. When the time came to grade the master negative, the light changes found to be correct in the test negative were used for the master grading.

Because the film was printed in contact, emulsion to emulsion, and the stripe was coated on the base side of the film, it was not possible to project the print in the correct manner and at the same time have the magnetic head scan the stripe. As this scanning was essential, a reversing mirror was used on the lens to project the picture the correct way. From the point of view of finding out whether striped positive film could be put through developing baths after exposure and then used for recording, this need for a reversing mirror was no great obstacle, but if prints are to be capable of use on all 16mm magnetic projectors without modification, then prints must be made on one-to-one optical printers.

Dust was the greatest enemy during printing and it was never completely defeated. An improvement was effected by injecting a fine spray of water into the printing room before work commenced and allowing time for the dust to settle. A further improvement was gained when the printer was mounted on a trolley and taken into the air-conditioned developing room.

Lip Synchronization

The successful use of prestriped positive stock developed after printing encouraged us to undertake lip synchronization. Experience in Tanganyika suggested that, for practical purposes, camera, recorder and projector could be relied upon to run at speeds which would remain constant enough for lip synchronism to be obtained for periods of at least one minute in any take. The major difficulty to overcome was to ensure that any difference in the speed of the camera and projector could be compensated.

Provided a slight change in pitch from the original recording was acceptable, it was possible to alter the tape speed by means of the mechanical control. An excellent starting point for correction was provided by the frequency injection control. The lack of mechanical or electrical link between the recorder and projector meant that synchronism had to be obtained by sight and ear. In this respect, a third feature of the recorder proved most useful. It made it possible to hold the tape in a "stand-by' position while the capstan ran up to speed, and upon moving the starting lever further over, the tape was caught between the pinch roller and capstan and started virtually instantaneously. Provided proper care was taken in maintaining the speed-constants throughout the process, from camera to re-recording, synchronism was always achieved.

Conclusions

The project was prematurely terminated due to events in the Middle East and many questions remained unasked and unanswered; nevertheless, it was found possible, by the use of magnetic striped materials, to produce material on the spot suitable to the needs of fundamental education. The capital outlay was reasonable, some £3,500 for equipment, and a two-man production team meant reasonable recurrent charges. Despite the fact of having to set up the project from scratch, five complete news magazines were made ready for screening at a shooting ratio of 2½ to 1, and the total floor space required for production purposes, including office accommodation, was 350 sq ft. The fact that the stripe stayed on the positive film during development made it possible for the unit to be self-contained, and the use of ferromagnetic materials obviated the more difficult and costly photographic process for the production of sound.

Time has passed since the project was first conceived. Considerable technical progress has since been made in providing equipment for exploiting the benefits of striped film. In this connection, and since the project terminated, there has been an opportunity to use the projector link for re-recording from one striped copy to another, and it worked most satisfactorily. Copies have also been made on a one-to-one optical printer using film striped on the base and film striped on the emulsion. In the latter case, it was the balance stripe which failed to stay on during processing. There was much less damage to the recording stripe. In one test the printer light was diffused, but the increased softness of the print offset any gains in other directions, and the print made by direct light proved to be the most satisfactory.

What the future holds cannot be foretold, but it would seem that there will always be a need for low-cost production methods in the field of fundamental education, which can be undertaken on the spot, if the visual moving image is to be fully exploited. Some of the problems met with in the Pilot Project may find other solutions, for example, the use of laminated stripe. Alternatively, as John A. Maurer has suggested,* 16mm direct reversal film may yet be treated with professional seriousness, in which case it may be possible to prepare a duplicate negative from the direct reversal original, and print this on prestriped positive on a normal step-by-step contact printer. The picture and stripe would then be in a normal relationship thus obviating optical printing to get the image the correct way round. The advantages of single-system cameras recording on striped reversal film could then be exploited to the full by taking the sound off the stripe onto full-coated stock for editing purposes with the dupe negative.

* John A. Maurer, "Technical opportunities in the 16mm and 8mm fields," *Jour. SMPTE*, 65: 586–590, Nov. 1956.

Problems of Small Laboratory Operation

By JOHN I. NEWELL

This paper deals with a small laboratory's solution of problems of duplication and processing in an essentially low-volume area of the United States. Specifically, the paper describes one method of making black-and-white reversal release prints of high quality, and another method of reversal duplication utilizing low-cost, positive-type emulsions. The paper also discusses 16mm negative developing and comparative results achieved through the use of Hoffman PR-400 developer.

The problems involved in the organization and operation of a small motion-picture laboratory differ rather widely from those encountered by large laboratories in high-volume-production areas.

Western Cine Service, Inc., was organized in the Fall of 1952. At that time, no other processing facility existed in Colorado or in any bordering state. However, despite the enormous geographic area, the market was one of essentially low volume.

The desire was to operate as complete a service as was practical within the limitations of the market. Initially we offered 16mm and 8mm black-and-white reversal processing and duplication. Two-hour processing service was standard procedure for such film consumers as television stations, sports-film cameramen, and spot-commercial producers.

Growth was rapid, and in the ensuing months we expanded our laboratory to include such other required operations as negative developing, positive developing, sound recording, an equipment sales and rental department, a titling and animation service, and editorial facilities. All of these related services were inaugurated after a careful investigation and evaluation of the potential market of the area. In every case, the volume demand was low, but the signs all pointed to growth. In order to accommodate this growth, it was necessary to install equipment that could operate profitably at low volumes, yet be flexible enough to satisfy peak loads and growing demand. The developing machines selected for this purpose were manufactured by Houston Fearless of Los Angeles. They include one Model 11-B, one Model K-3, for black-and-white reversal processing, and two Labmasters for negative and positive processing. This gives the laboratory a daily maximum capacity of over 35,000 ft of reversal, negative and positive film on a single working shift.

A Bell & Howell Model "J" Printer, modified with a dissolving shutter, is utilized for the duplication of all black-and-white or color original films. One of the problems faced in connection with reversal black-and-white duplication was the absence of a satisfactory reversal dupe stock, in terms of our processing. The stocks designated for that purpose by the film manufacturers were exhaustively tested and found lacking in some respects. Soundtracks printed on them had poor signal-to-noise ratio because of the relatively high minimum base density, caused primarily by the tanning action of the bleach. They were color blind and could not be used satisfactorily from color originals.

A good portion of the business was dependent on low print-order requirements and it was desirable to offer a better quality duplicate. Many emulsions were tested and two were finally chosen as offering the most promise. They were Eastman Plus-X Reversal Type 7276 and Du Pont 802A sound-recording film. The Plus-X Reversal is used in making black-and-white-reversal duplicated from color originals and black-and-white originals. This method offers duplicates of

Presented on May 1, 1957, at the Society's Convention at Washington, D.C., by John I. Newell, Western Cine Service, Inc., 114 E. 8 Ave., Denver, Colo.
(This paper was received on May 14, 1957.)

excellent pictorial quality and also permits soundtrack duplication at excellent level and signal-to-noise ratio.

In the case of less critical users, Du Pont 802A is used. It offers a reasonable quality duplicate at less than one-half the stock cost of reversal duplicating film. It was found that this emulsion would reverse easily in the standard process and was available in both sound and silent perforations. The initial tests, while adequate for workprint quality, were found to have excessive contrast. The black areas of the reversed image had a density in excess of 4.0 as measured on an Ansco-Macbeth Densitometer. We experimented with a method of prefogging the stock to reduce the toe density of the emulsion.

The film was run through the Bell & Howell printer with a low illumination level, and we were successful in obtaining a maximum reversed density of about 2.2. The gradation, grain and scale of the prefogged 802 was, in our opinion, satisfactory for workprints and sports-film duplicates. It has also been used successfully in making workprints of good quality from color originals. It was noted that an apparent shift of the color-blind sensitivity of the emulsion took place as a result of the fogging operation, and color scenes were reproduced with acceptable gradation even when the original scene contained saturated amounts of red and yellow.

It would be well to repeat, at this point, that these duplicating processes were evolved because of the limitations of the market area. We agree that a method of release printing via the duplicate negative-positive print route is superior. However, this method is more costly, and more time consuming, and while warranted on volume print orders, it is not adequate for the customer who desires only one or two copies of his original.

Our practice is to employ the method of lowest cost to the client, on any print order. In our case, it becomes attractive, costwise, to make a dupe negative if three or more prints are desired. When fewer than three are required, we utilize the direct reversal duplicating method.

The experienced laboratory technician realizes immediately that the methods outlined above use emulsions that are not perforated in printer pitch. In practice, this discrepancy has not been a serious factor, and it has been found that good contact can be maintained in the printer without adjustments other than the standard pressure and operative spacing recommended for release positive film.

Another problem encountered in the laboratory concerns the processing of negative emulsions. Here, again, the volume is not large and it was not feasible to provide a large high-speed machine for this purpose. However, it was desirable to process negative films as quickly and efficiently as possible. The Houston Fearless Labmaster, acquired for this purpose, proved an efficient machine, but was able to develop only 800 ft of negative per hour, using D-76 Eastman developer at standard time and temperature. In order to speed up the low rate, we experimented with increased agitation, Kodalk fortified formulas, high temperatures and other means. In most cases we found that image quality, in terms of grain, contrast and directional processing effects, was compromised.

Two years ago we obtained a sample of the Hoffman Laboratories developer known as PR-400. This formula had been very successfully used for fine-grain development of 35mm miniature films, and roll and sheet films of various sizes. It enjoys a following among people who desire large speed increases in the ASA ratings of their films. Our tests indicated that it would be very well suited for motion-picture film development. Enough of the prepared powder was obtained to mix 20 gal of developer plus a supply of the PR-400R replenisher formula.

This *initial* solution has been used to process nearly 100,000 ft of negative film in the past year. Continuous replenishment at a low rate, plus filtration of the entire bath has helped to maintain the working quality. It should be noted that the inherent keeping quality of this developer far exceeded expectations.

At standard ASA ratings, such films as Tri-X negative, Plus-X negative, Du Pont 930 and 931 negatives and duplicating negative Type 7203, are immersed for 2 min at 72 F in this developer. The delivery rate is tripled over that obtained with D-76 and the cost of chemicals is reduced.

Image quality is very noteworthy. Grain is at a minimum, even in forced processed negatives. Contrast is normal throughout the scale of the film. No staining or spotting problems have ever been encountered. Direct comparisons of identical negative materials processed to equal gamma in PR-400 and D-76 have been made. The PR-400 has proven to be a finer-grain formula. In terms of density range, PR-400 and D-76 are quite similar. On several occasions Eastman Type 7302 release positive has been processed in this developer. The low-contrast result seems well suited for telecasting. Kinescope recording film Type 7374 responds very well in this formula and it has proved quite simple to achieve the indicated gamma of 1.1 very consistently. In point of fact, we have been able to pinpoint our controls with far less drift than ever before.

Early in 1956, it was decided to expand our operation once again, and offer color processing. This problem was approached with a reasonably well-educated eye on the market. Anscochrome film seemed to offer the most expedient method of satisfying the growing demand of the sports-film people, as well as regional TV stations, who are in the process of acquiring color transmission and studio equipment.

Again, Houston Fearless built a machine to our specifications. The machine was delivered and installed last December. An integrated replenishment system was designed and installed by our own technicians, and in January of this year color operation was started. The color capacity is about 15,000 ft per shift. In football season, we offer three-shift operation on the weekends in both black-and-white and color.

We feel we have been very successful in our solution of the problems of operation of a small service laboratory. With the ever-expanding economy of a rapidly growing West, we are confident of a future of continued growth, coupled with new knowledge of how to better serve the needs of the film consumer.

Xenon Electronic Flash Sensitometer

By CHARLES W. WYCKOFF
and HAROLD E. EDGERTON

An electronic xenon-flashlamp sensitometer is described for use in black-and-white or color process control. It is an intensity-scale instrument with three different exposure durations. The longest exposure, 1/100 sec, is useful for normal picture-taking control. The two other durations of 1/1000 and 1/10,000 sec allow the laboratory technicians to study film and development characteristics falling in the range of high-speed photography. Color of the light approximates daylight quality without the use of filters and the quantity of light is remarkably constant.

Sensitometry is generally taken for granted by most photographic-minded people and is assumed to be an obscure occupation taking place back in some faraway hidden darkroom. The instrument itself, called a sensitometer, is usually visualized as a piece of equipment so cumbersome and complex that it has no practical application for most darkroom technicians. If this happens to be your opinion, you are absolutely right! Sensitometers are cumbersome, complicated gadgets. As such, perhaps they rightfully belong hidden away in some back room. The Xenon Electronic Flash Sensitometer is an instrument with which it is hoped to popularize the field of sensitometry and bring it out in the open for a more widespread use. It is a small noncomplicated and convenient instrument for the average photographic technician to use in his daily work.

How can such a small and yet reliable sensitometer aid the darkroom technician? Even though it can be used for studies of short-exposure reciprocity failures, it is equally effective for such routine tasks as a check on developer activity, effectiveness of development techniques, contrast control, film-speed determination and even color-filter selection for the balancing of color films. Of course, the old-fashioned sensitometer could also be used for some of these same tests. However, lack of convenience and general complexity precluded its use in most cases. By creating a compact, simple and dependable instrument, the Xenon Electronic Flash Sensitometer should find its way into modern darkrooms as a most useful and profitable tool.

Presented on May 3, 1957, at the Society's Convention at Washington, D.C., by Charles W. Wyckoff (who read the paper) and Harold E. Edgerton, Edgerton, Germeshausen & Grier, Inc., 160 Brookline Ave., Boston 15, Mass.
(This paper was received on May 3, 1957.)

Several years ago, when Edgerton, Germeshausen & Grier, Inc., took on the task of high-speed photography for the Atomic Energy Commission Bomb Test Program, it was decided that the processing of the photographic records was just as important as the initial recording. Our primary task was that of collecting data in the form of measurements made from photographically recorded images. Because both geometric as well as photometric measurements were desired, it became obvious that precise control would have to be maintained over both the recording as well as the processing phase. The extent of the controls would be dictated by the degree of accuracy required of the overall task.

An educational program was commenced for the purpose of learning the potentialities of some of the commercially available photographic emulsions. It was evident from the start that a sensitometer would be a most important instrument for the study of emulsions from the standpoint of exposure as well as development. It was recognized that most of the exposures involved would be outside the normal range and well into the reciprocity-failure region of high-intensity, short-time durations.

Because the primary photographic work of EG&G is in the range of high-speed photography, typical exposure durations are too short to be within the limit of commercially available sensitometers. It was, therefore, necessary to design a sensitometer to suit our particular needs. Because of pioneering experience in the field of producing electronic-flash equipment, it was only natural that such a light source be adopted for the illumination system.

Some of the limitations of the tungsten lamp have been partly eliminated by the use of a flashing gaseous discharge tube as the light source. A number of such instruments have been constructed, and their usefulness indicates that this system could be the ultimate illumination method for all sensitometers. Figure 1 is a typical circuit diagram of an EG&G Mark VI Xenon Electronic Flash Sensitometer. A built-in voltage-stabilizer transformer insures constant output with as much as ±20% line-voltage fluctuation. Figure 2 shows the instrument and illustrates its compact and efficient design. Note the three push-buttons appearing on the front deck of the instrument. These are the exposure-time selectors.

Figure 3 is a cutaway schematic presentation of this sensitometer. Beginning at the bottom of the diagram, the flash-tube can be seen in a housing which is open at the top. Directly above this is a filter labeled Variable Area Filter.

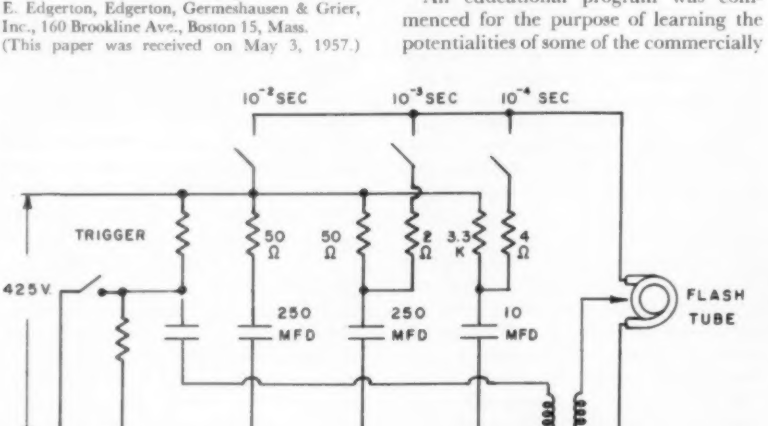


Fig. 1. Typical circuit diagram of an EG&G Mark VI Xenon Electronic Flash Sensitometer.

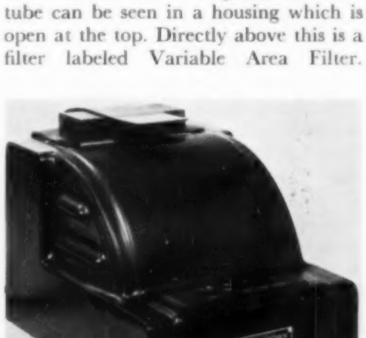


Fig. 2. Exterior view of EG&G Mark VI Sensitometer.

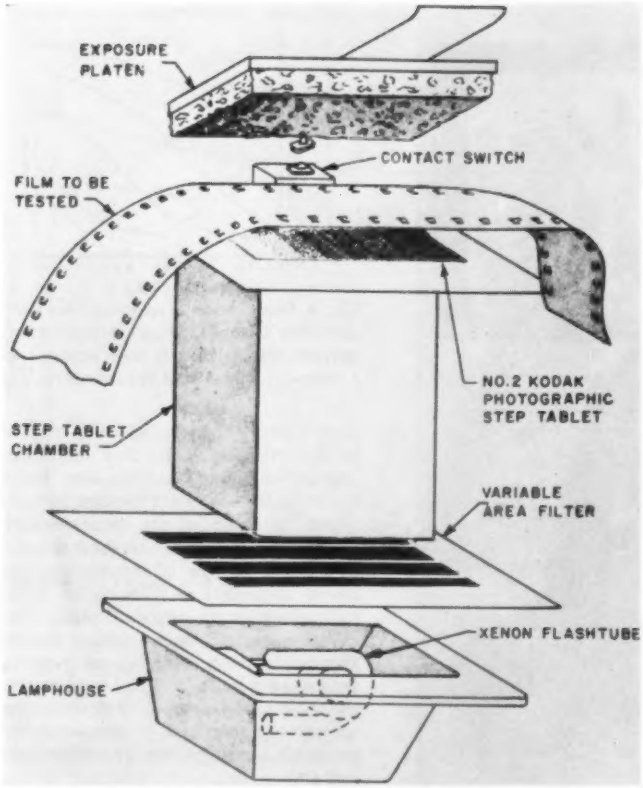


Fig. 3. Optical schematic of Mark VI Sensitometer.

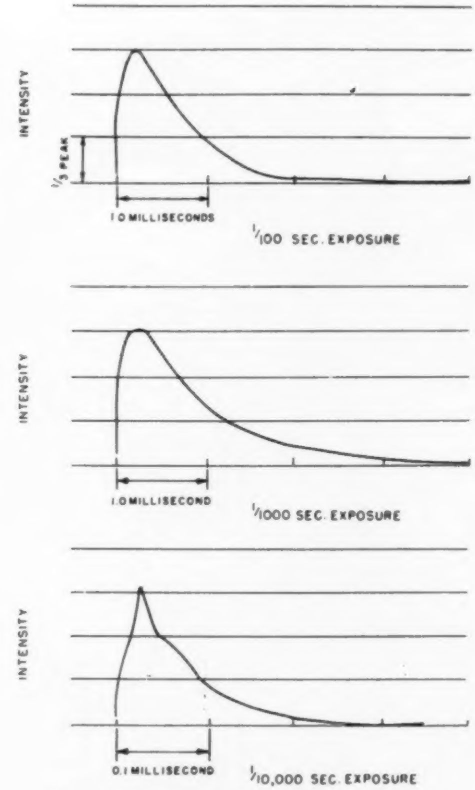


Fig. 4. Oscillograms of the three light pulses.

The purpose of this filter is to regulate the total amount of light desired to fall on the photographic material being tested. Standard neutral-density filters may be used if desired. Generally, because of their undesirable properties, they are not preferred. We have designed a set of variable-area filters which eliminate many of the difficulties involved with neutral-density filters. If it becomes necessary to alter the spectral quality of the light being emitted, a color filter may be inserted along with this variable-area filter. Immediately above the filter is a chamber, the top of which contains a No. 2 Kodak photographic 21-step tablet which serves as the exposure scale. The purpose of separating this exposing scale a given distance from the filters and light source is to ensure even illumination in the exposure plane.

The photographic film to be tested is placed in contact with the exposing scale, emulsion side down. It is held in position by the exposure platen shown at the top of the diagram. The flashtube is made to pulse by means of a contact switch when the exposure platen, holding the film in contact with the scale, is depressed. Mechanically, such an instrument is much more simple and convenient to use than the incandescent type. It does not require a mechanical shutter because the flash time is determined by the electrical flashlamp circuit conditions. With our latest instrument, there are three possible exposure durations which the user selects by simply depressing the appropriate pushbutton.

Figure 4 presents oscillograms of the three light pulses. By definition of the American Standards Association, the duration of a flash from such a light source is limited to the time between the one-third peak points. The top diagram of Fig. 4 represents an oscillogram of the 0.01-sec pulse. The vertical lines along the X-axis are 10-msec divisions. The middle oscillogram is a record of the 0.001-sec pulse. The time scale in this record differs from the previous one by a factor of 10. Each vertical division along the abscissa in this case represents 1 msec. The bottom record is that of the 0.0001-sec pulse, in which the vertical divisions are 0.1 msec.

The longest exposure, 0.01 sec, is useful for normal picture-taking control since this is the exposure time most commonly found in typical everyday photography. A 0.001-sec pulse is provided for those who use short peaking photoflash or low-voltage electronic flash equipment. Users of photographic sound-recording equipment, high-voltage electronic flash units, or other high-speed photographic recording instruments are provided with a 0.0001-sec exposure duration. Thus, the laboratory technician is enabled to study film and development characteristics falling in the range of high-speed photography. He can, furthermore, compare his results with those obtained in the normal 0.01-sec range and thereby measure any reciprocity failure which may be present.

Light incident upon the exposure plane can be measured directly by the use of a General Radio Light Meter, Type 1501. Figure 5 shows the arrangement for using such an exposure meter to measure and calibrate the total light from a flash sensitometer. After first removing the exposing scale, the exposure meter is positioned on top of the instrument with its collecting window coincident with the sensitometer exposure window. They are electrically interlocked by means of the extension cable which can be seen in the photograph connecting the exposure meter and the sensitometer.

Depression of the control button on the meter causes the sensitometer to flash and the meter to integrate and hold the light reading. The units of light thus measured in the exposure plane are in lumen-seconds per square foot. Because $D - \log E$ characteristic curves and the like are generally presented with exposure units in meter-candle-seconds, it becomes necessary to multiply the resulting reading by a constant factor of 10.76 in order to obtain meter-candle-

Fig. 5. General Radio Integrating Exposure Meter being used to measure sensitometer light output.

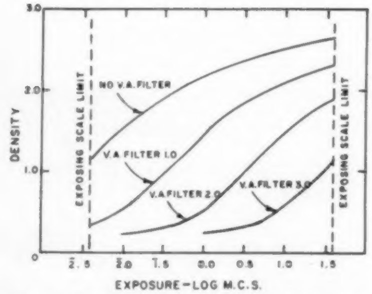


Fig. 6. Comparison tests using the variable-area 1/10, 1/100 and 1/1000 transmission filters. Plus-X film exposed at 1/100 sec on Mark VI Sensitometer.

seconds. Thus, a means is made available for determining the exposure index in accordance with the 0.3 average gradient method as recommended by the American Standards Association.

The light output of the three available exposure durations is approximately 1000 mcs (meter-candle-seconds) for the 10^{-2}-sec pulse, 5000 mcs for the 10^{-3}-sec and 40 mcs for the 10^{-4}-sec exposure. These values are normalized to one value by the use of specially constructed variable-area filters inserted between the light source and the exposing step tablet. With the compensators in place, the amount of light incident on the exposure plane is on the order of 4 lm-sec/sq ft or 40 mcs.

The design of the variable-area filters is presented as a line pattern to ensure an even field of illumination in the exposure plane. The compensators have lines running lengthwise with respect to the exposing scale. For additional attenuation other variable-area filters are available with lines running at right angles to those of the compensators. This arrangement prevents the formation of a moire pattern of interference and allows uniformity of illumination to be maintained in the exposure plane. The effective neutral-density values obtainable by this method range from 0 up to a density of 3.0. It becomes a comparatively simple task to calculate the amount of attenuation by measuring the geometric areas through which the light will pass.

With 40 mcs of light available, such emulsions as Kodalith or Reprolith or the new gravure-type copy emulsions may be studied. The more sensitive emulsions require additional filtration such as presented in Fig. 6. Since it is a variable-area type of filter rather than a so-called neutral-density type, light will pass through unaltered spectrally and it is, therefore, a true neutral attenuator. With the proper spectral-quality light source, these filters may be used with color films such as Kodachrome, Anscochrome, Ektachrome, etc.

The relative spectral quality of an electronic flashtube filled with various

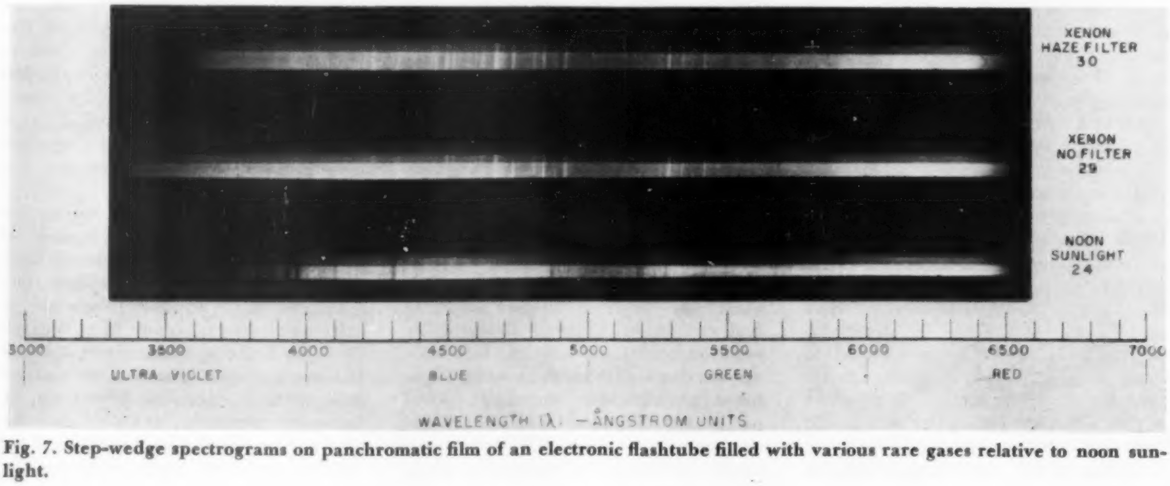


Fig. 7. Step-wedge spectrograms on panchromatic film of an electronic flashtube filled with various rare gases relative to noon sunlight.

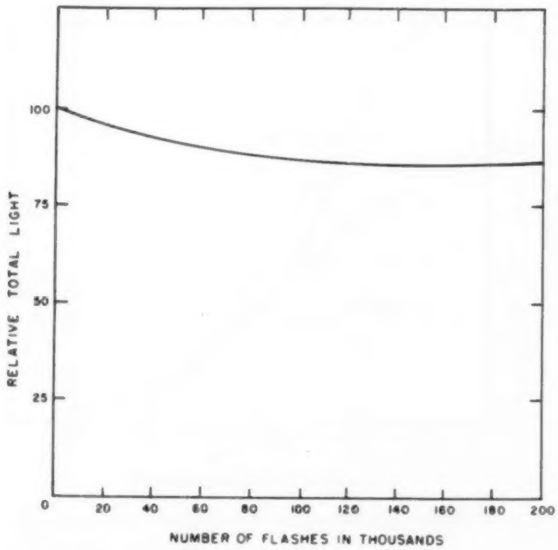


Fig. 8. Light output as a function of tube life.

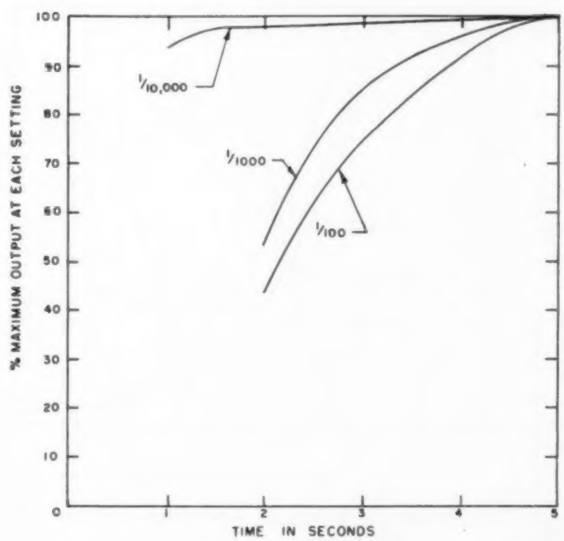


Fig. 9. Charging-time characteristics of flash circuits in Mark VI Sensitometer.

gases is shown in Fig. 7. These are step-wedge spectrograms made on panchromatic film and compared with an exposure made to direct noon sunlight. It can be seen from this figure that a xenon-filled tube is a close approximation to sunlight. The relative spectral output changes only slightly as a function of circuit conditions. The distribution of spectral energy is approximately the same for 0.0001 sec as that for 0.01 sec.

Tube life, or the number of flashes a particular tube has cycled through, will not alter the spectral distribution of the light, although the total light will decrease somewhat. This is shown in Fig. 8, which is a presentation of relative total light plotted as a function of the number of flashes in thousands. Starting with a new tube, the total light value is set at 100 on the Y-axis. A loss of light, amounting to approximately 10%, takes place at a gradually decreasing rate over the first 40,000 flashes. From then on, the light loss becomes less uniform, amounting to only a few per cent up to some 200,000 flashes. Thus, the total loss of light over 200,000 flashes amounts to approximately 15%. It can be seen that the repetition from flash to flash is of a high order, provided that there is sufficient waiting or charging time between flashes.

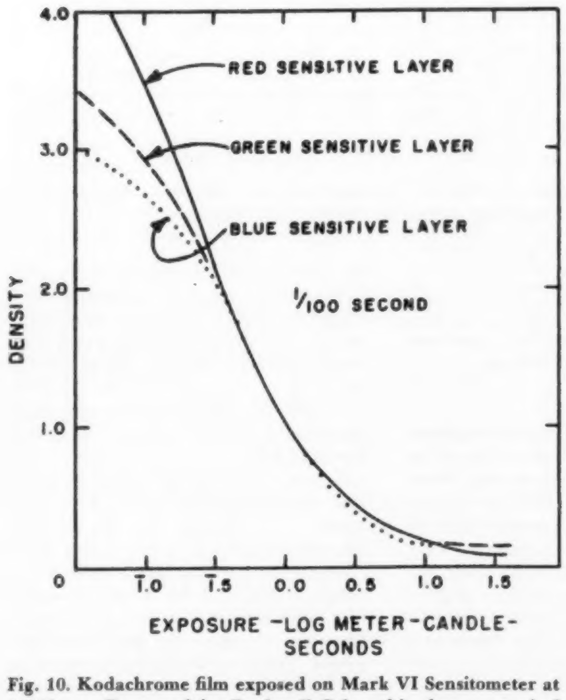


Fig. 10. Kodachrome film exposed on Mark VI Sensitometer at 1/100 sec. Processed by Rockwell Color, this shows a typical daylight color balance.

The charging time as a function of maximum light output for each of the three circuit conditions is shown graphically in Fig. 9. With only a 2-sec waiting time, both the 0.01-sec and the 0.001-sec pulses will produce approximately half the total light. After 5 sec, all three of the circuits will be fully charged and the light output from flash to flash will be repeatable within a few per cent. For consistency, it is therefore necessary to wait at least 5 sec before making another exposure. In actual practice it is difficult to make exposures faster than one every 5 sec.

Figure 10 presents characteristic curves of Kodachrome film exposed for 0.01 sec on a Mark VI Sensitometer. These curves were plotted from Kodachrome film processed at Rockwell Color, Inc., in Cambridge, Mass. They appear to be identical with Kodachrome film processed at Eastman Kodak's laboratory at Fairlawn, N. J. When Kodachrome film is exposed for times shorter than 0.01 sec, it is interesting to note the effects of exposure reciprocity failure on the three different layers. The blue-sensitive layer is apparently not affected for exposure times as short as 0.0001 sec. The green-sensitive layer begins to fail at approximately 0.001 sec, whereas the red-sensitive layer starts to fail almost immediately at times

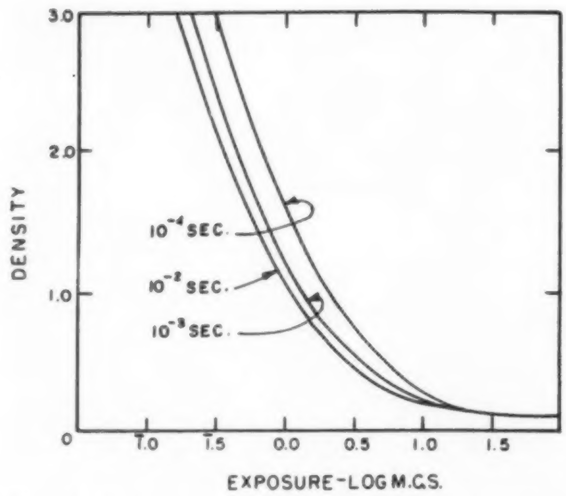


Fig. 11a. Reciprocity failure of Kodachrome red-sensitive layer.

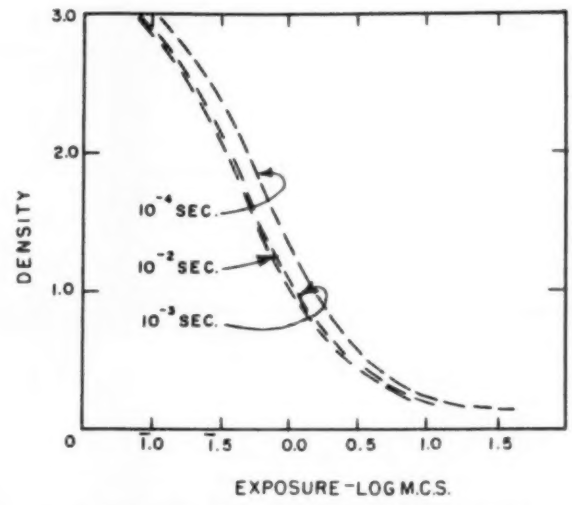


Fig. 11b. Reciprocity failure of Kodachrome green-sensitive layer.

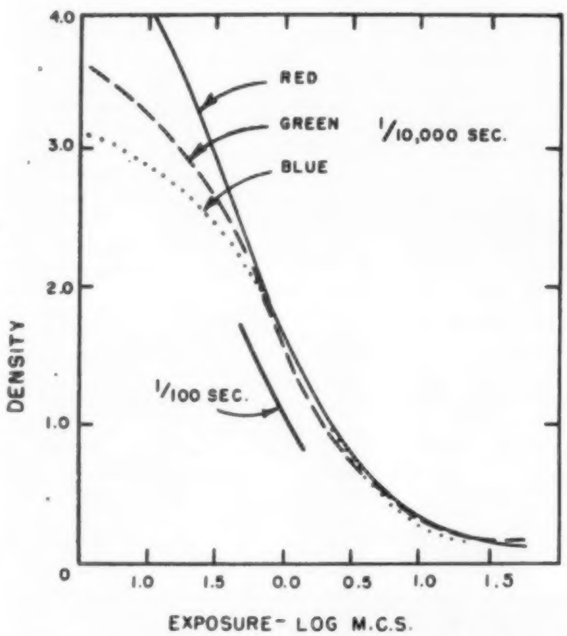


Fig. 12. Kodachrome film exposed at 1/10,000 sec using color-compensating filters 30Y + 20M. Note restoration of color balance, but with a loss of speed.

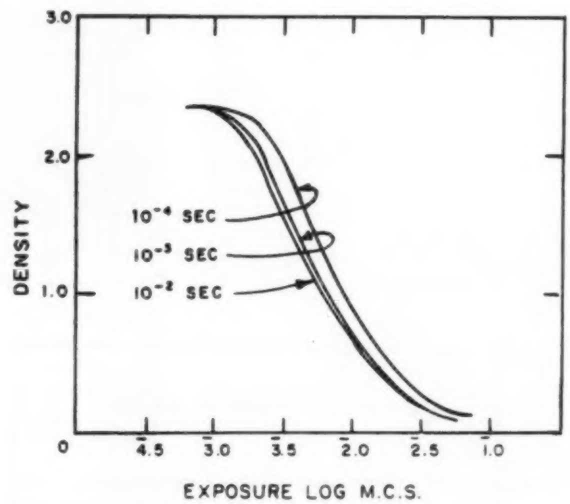


Fig. 13. Polaroid transparency film, Type 46L. Note exposure reciprocity failure for the 10^{-4}-sec exposure.

shorter than 0.01 sec. This can be seen graphically in Figs. 11a and b.

Figure 11a presents the characteristic curves of the red-sensitive layer when subjected to 10^{-2}-, 10^{-3}-, and 10^{-4}-sec exposure time. Note the extreme reciprocity failure of the 10^{-4}-sec curve. Figure 11b depicts the failure of the green-sensitive layer of Kodachrome film. Because no failure exists in the blue-sensitive layer, the curve as presented in Fig. 10 may be assumed to be typical of all three exposure-time conditions.

In order to bring Kodachrome film into neutral color balance at exposure times shorter than 0.01 sec, it would be necessary to use color-correcting filters either over the film or over the camera lens. Thus, for an exposure time of 0.0001 sec, it would be necessary to use a 30Y and a 20M filter to bring the three layers into balance. Such a filter combination was used, and the results are plotted in Fig. 12. This results in a sensitivity loss of a factor of 2. Compensation must therefore be made in taking a picture to allow for this loss.

The next few figures represent some of the photographic problems which may be studied by means of the sensitometer. Figure 13 depicts a sensitometric study of the new Polaroid transparency material 46L. Figure 14 illustrates the behavior of experimental Kodak S.O. 1177 emulsion. This film, recently made generally available, is known as Kodak Royal-X Pan.

Another use for the sensitometer is that of studying resolutions of the various emulsions of interest. For this purpose, the sensitometer is used simply as a contact-printing box. The exposing step tablet is replaced by a photographic-film, high-resolution target. It is further necessary to reduce the size of the light source. This is accomplished by replacing the compensator and variable-area filters with an opaque plate containing a $\frac{1}{4}$-in. hole in the center and through which the

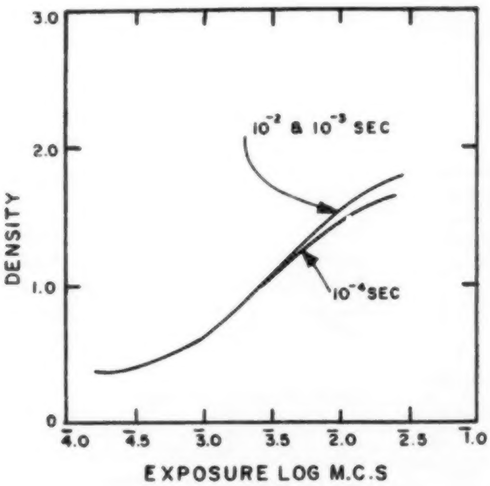


Fig. 14. Exposure reciprocity failure. Kodak Experimental Film, S.O. 1177 (Royal-X Pan).

light will pass. This will create some fall-off in light toward the ends of the exposure window, but exposures made in the central region will be satisfactory. Neutral-density filters may be placed over this hole if further attenuation is necessary. The film to be tested is placed, emulsion side down, in contact with the resolution target.

Figure 15 shows a typical result obtained by this method. This illustration is a plot of the resolution in lines/mm as a function of exposure. Some of the other applications for this instrument are that of process control, film-speed testing, latent image-fading characteristics, color-film balance, and the effects on film characteristics when subjected to gamma radiation fogging. Because of the extreme simplicity of this instrument, it is our hope that it will encourage a great deal more research in the photographic-emulsion field. Sensitometry can thus be practiced by a great many instead of the very few who use it presently.

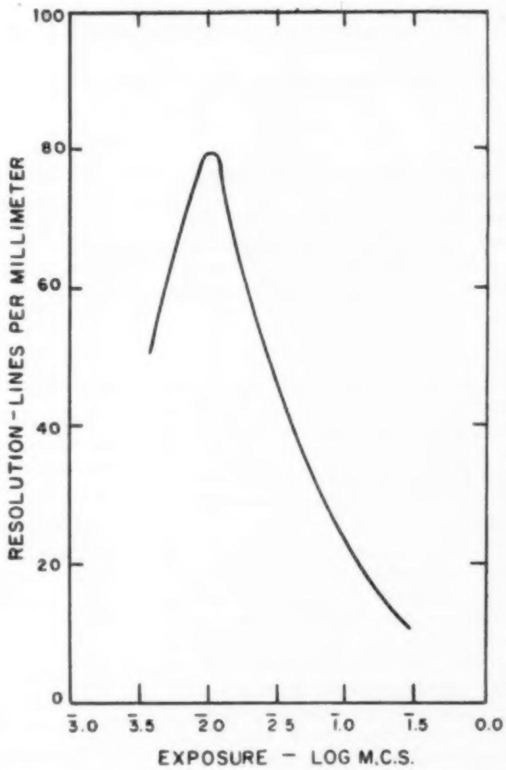


Fig. 15. Emulsion resolution as a function of exposure for Kodak S.O. 1177.

Discussion

Kenneth Morgan (Fairchild Camera & Instrument Corp.): Could you explain how you diffuse the light to get a uniform area underneath the sensitometric tablet?

Mr. Wyckoff: The flashtube is situated in a rectangular lamphouse whose walls act as diffuse reflectors. The top of the lamphouse is open and presents an area of fairly even illumination. The variable-area compensators and filters cover this opening and regulate the amount of light incident upon the exposing step tablet by reducing the effective area of the opening. The walls of the scale chamber are also diffuse reflectors and further diffuse the illumination making it somewhat difficult to say just where the light source really is.

Mr. Morgan: That source is sufficient without any other optical diffuser?

Mr. Wyckoff: Yes. There are no other gadgets enclosed. The light is flat across the exposure plane to plus or minus 3%. It is obviously not perfect, but is within the tolerance quoted.

L. A. D. Colvin (U.S. Naval Proving Ground, Dahlgren, Va.): Is this generally available? And if so, at what cost?

Mr. Wyckoff: Yes, it is available and the cost is $600.00.

Rodger J. Ross (Canadian Broadcasting Corp.): I don't think you referred to the problem of the reproducibility of exposure between the two machines at different points, so that some comparison could be made of the level of exposure.

Mr. Wyckoff: I assume that you mean, if the two machines are side by side, then what is the cross comparison? The light level of each instrument can be measured in the exposure plane by means of the General Radio Integrating Exposure Meter referred to in the text. A comparison of these readings gives the relation between the instruments. When doing quantitative sensitometric work, one should periodically measure the light output because the value of the capacitors may change somewhat if left unused for long periods of time. If this condition exists it would be advisable to apply power to the instrument for an hour or so to give the capacitors a chance to "reform" themselves. It is a comparatively simple task to measure the light output using the integrating exposure meter and is the best insurance for standardization.

A Multipurpose, Continuous Processing Machine for Instrumentation Photography

By D. S. ROSS

Especially adaptable to instrumentation needs, for long or short runs of consistent quality, the transportable Type T246 Mark 3 Automatic Tri-Film Processor offers automatic programming, ready adaption to various processing techniques, automatic and leaderless loop formation, combined with a small size. The machine may be adjusted simply, in a few minutes, to process and dry four tracks of 16mm, two of 35mm or one of 70mm film at speeds up to 6 ft/min.

In the last decade or so, modern technical society has come to lean heavily on photography as a primary means of recording events and actions which provide keys to the analysis and control of many industrial, research and military programs.

We have access today to a wide variety of photographic recording equipment which may be applied directly to almost any kind of problem. An equally wide variety of users takes advantage of photographic instrumentation systems, only to find that film processing machinery, adaptable to and convenient for their purposes, is extremely hard to find. Except for a few elegant and specialized single-purpose processors, a considerable gap exists between the simple reel-and-rewind devices and the larger processors of the professional motion-picture class.

Since much of the data recording which now takes place needs closely controlled processing to ensure accurate and reproducible results, it becomes necessary to have processing done at a static installation where appropriate machinery and trained operators are located.

However, few users of photographic instrumentation find it economical to establish an elaborate installation of this type, and so the majority are obliged to have their films processed by a second party, with the attendant drawbacks of loss of time, possible loss of film in transit, or the danger of a breach in industrial or military security.

Consequently, there is a clearly established need for a new and special class of film-processing machinery, which will satisfy as far as possible the catholic requirements of modern photo-instrumentation. Not the least of these requirements will be to give to the user full control over the photographic process by providing a machine which he can own and operate under his own jurisdiction, and which will yield consistent results of good quality.

Presented on May 3, 1957, at the Society's Convention at Washington, D.C., by D. S. Ross, Canadian Applied Research Limited, 1500 O'Connor Dr., Toronto 16, Canada.
(This paper was received on April 29, 1957.)

General Specification

It is suggested that the following basic characteristics must be present in a film processor designed for general-purpose photo-instrumentation:

(a) *reliability* in performance and in producing processed film to high standards;

(b) *flexibility* in adapting to various classes of film and processing techniques;

(c) *transportability*, so it may be brought on or near the scene of operations;

(d) *simplicity* in setting up, loading, operation and maintenance; and

(e) *productability*, designed to be manufactured at a cost compatible with the intended type of employment.

These factors cannot be stated in any particular order of priority. They are all interlocking, and it is the problem of the designer to consider each in conjunction with all the others, until a final balance is achieved.

Development of the Design

In developing such a machine, the design engineers at Applied Research Limited approached the problem somewhat in this fashion:

Flexibility in its use was to be one of the chief considerations, and in order to have this it was decided that the machine would be made to handle the three films most commonly used in photo-instrumentation — 16, 35 and 70mm.

To further the idea of flexibility, it was decided to have the option of using one or several tanks for each stage of the process as desired, and a means of sepa-

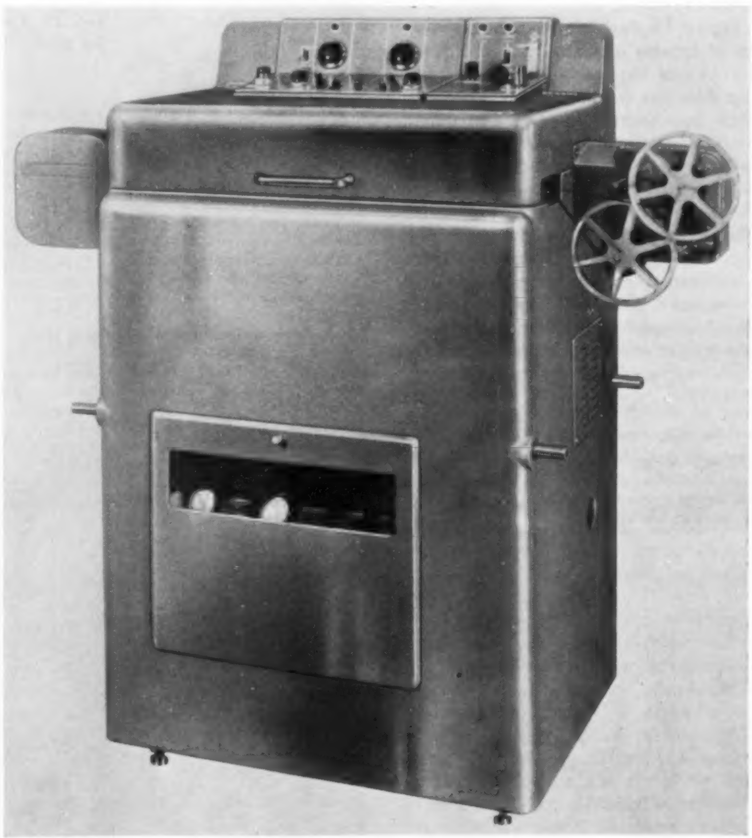


Fig. 1. Mark 3 Automatic Tri-Film Processor, showing the compact configuration of the machine.

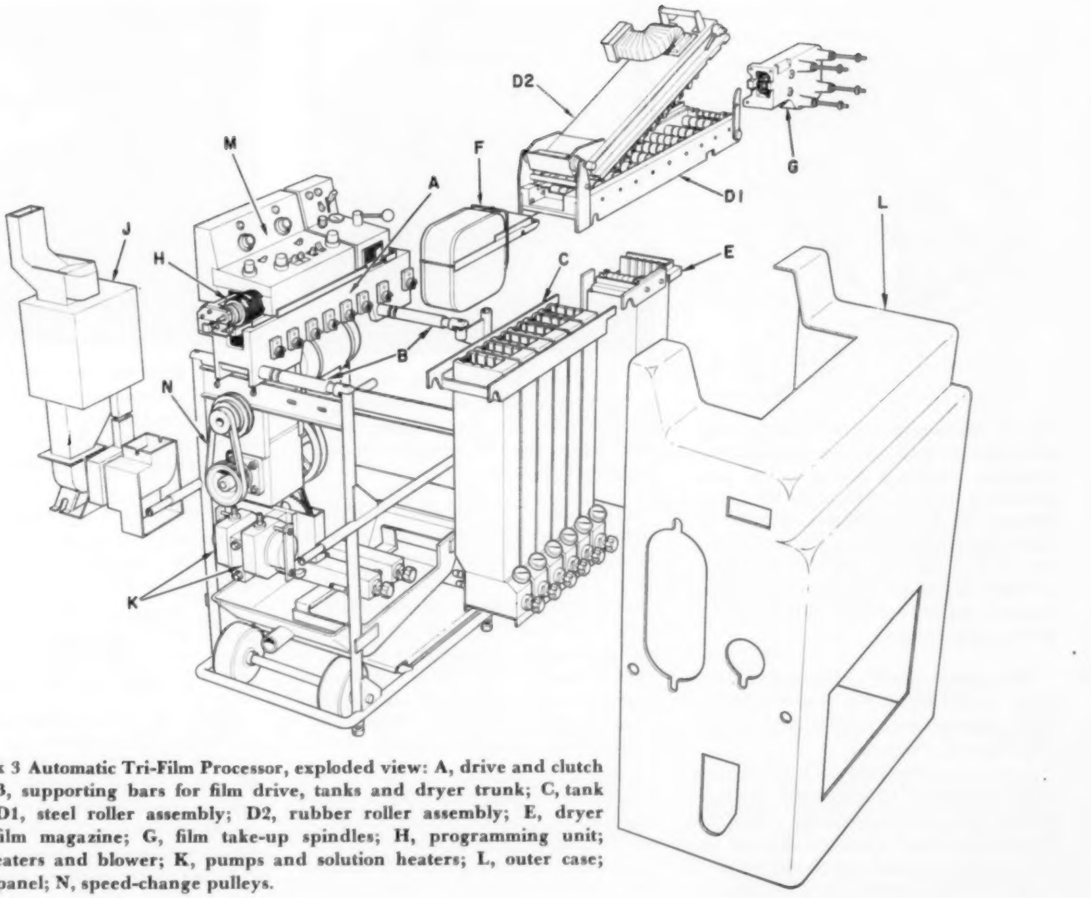


Fig. 2. Mark 3 Automatic Tri-Film Processor, exploded view: A, drive and clutch assembly; B, supporting bars for film drive, tanks and dryer trunk; C, tank assembly; D1, steel roller assembly; D2, rubber roller assembly; E, dryer trunk; F, film magazine; G, film take-up spindles; H, programming unit; J, dryer heaters and blower; K, pumps and solution heaters; L, outer case; M, control panel; N, speed-change pulleys.

rately pumping up to four types of solution was to be incorporated.

Since most modern films withstand processing at relatively high temperatures, arrangements were to be made to control the four solutions individually at temperatures up to 120 F. The machine was to be a "hot" machine, designed to operate above normal ambient temperatures, thus avoiding the weight and power required for cooling the processing solutions.

It was also decided that variable loop length in each tank, and a choice of three different film-transport speeds would be required to obtain the greatest possible flexibility in adapting to a variety of processes.

To obtain simplicity of operation, daylight loading, leaderless threading and automatic loop formation were established as prerequisites. Complicated controls were to be avoided.

Materials of construction were to be selected for their resistance to photo solutions at high temperatures.

As mentioned previously, all these desirable features were to be conditioned by and balanced with reliability, transportability, ease of maintenance and productability.

Production Design

Configuration. The design of the Mark 3 Automatic Tri-Film Processor which emerged is in the form of a machine weighing 550 lb, and which is transportable on a pair of wheels. It occupies a space $4\frac{1}{2}$ ft long, $4\frac{1}{4}$ ft high, and less than 2 ft wide (Fig. 1).

A modular design is employed in which the main components, such as the film transport system, the pumps, the dryer, the tank unit, and so forth, are attached as single units to a tubular-steel framework. A polyester-fiber glass case, which can be easily removed, covers the package. Figure 2 is an exploded view of the machine, with the main components identified.

Loop Formation. A unique feature of the Processor is its method of automatic loop formation.

The film magazine is placed on the machine, and the film is drawn out of it across a steel roller assembly (which is positioned above the tanks and the dryer trunk) and is attached to a take-up spool. A "lid" is then closed over the roller assembly. Inside the lid are sets of rubber idler rollers which sandwich the strip of film between themselves and the steel rollers.

When the "Start" button is pressed, a programming mechanism engages the first (and only the first) steel roller, causing it to rotate and to draw film out of the magazine. As the film feeds out of the magazine, it drops into the first tank, forming a freely hanging loop, which continues to grow in size until it has reached a length predetermined by the setting of the programming unit.

At this point, the programming unit engages the second steel roller, which is located between tank 1 and tank 2. As the second roller turns, it withdraws the film from tank 1 at the same rate at which it is being fed in, since the first and second driven rollers are locked together to the main drive chain. As a result, a free loop of fixed length is formed and maintained in tank 1, where it passes through the solution.

The second steel roller feeds the film it takes from tank 1 into tank 2 until, again, the proper loop length has been formed, at which time the programming unit engages the third steel roller.

Automatic formation of the loops proceeds in this manner through the six tanks and the dryer, until finally the film take-up spindle is actuated, and the processed and dried film is spooled up.

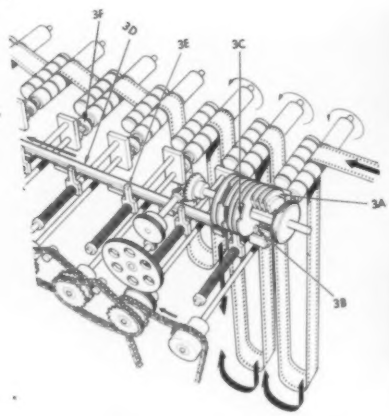


Fig. 3. Operation of the loop-forming mechanism: The chain drive (lower left) transmits rotational motion to the programming unit, 3A. The latch, 3B, drops through the slot in each disk, 3C, as each turns into position, causing the long bar, 3D, to move one step at a time, engaging a roller clutch, 3E, at each step. The diagram shows two loops formed, and a third partly formed.

The advantage of forming and holding loops by this method is that the film is under no tension whatsoever while in the wet stages of processing.

Programming Unit. Figure 3 shows how the Programming Unit is constructed and how it operates to actuate the rollers. It consists of a stack of slotted disks at 3A which, as they rotate, permit the stepped escapement of a metal bar, 3D, which itself actuates each roller clutch in turn.

A latch, 3B, on the end of the bar, drops through the slot 3C in each disk, as it rotates into position. The bar advances a step, releasing the clutch stop, 3E, for an individual roller. The clutch dog, 3F, is forced into contact with its opposite member on the end of the steel roller, causing it to turn.

Figure 3 shows two loops formed, and a third loop partially formed. It will also be seen that setting the slot in the edge of each disk to a predetermined number of degrees relative to the slot in the next disk determines the time interval between actuation of the clutches between any pair of rollers, and so controls the loop length of film formed between them. The simple process of setting the disks is shown in Fig. 4.

Film-Track Capacity. The film-transport roller system in the machine accommodates one track of 70mm film. By placing removable dividers (Fig. 5) in the tanks, the 70mm track width may be partitioned laterally to take two 35mm films, one 35mm and two 16mm films, or four 16mm films. The Processor can be converted for use with any of the three film sizes within a few minutes.

The threading of a single strand of 35mm film is shown in Fig. 6. Loop formation and programming take place in the same manner as for a single strand of film.

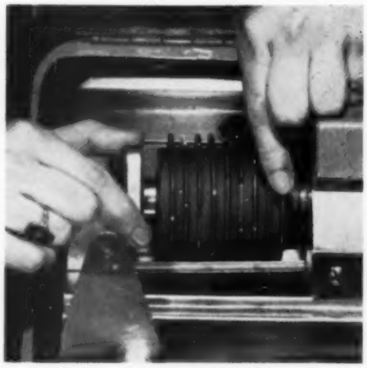


Fig. 4. Setting loop-forming timer disks on the programming unit: Loosening the knurled knob on the left permits the disks to be reset to control film loop-length in each tank.

Tanks. The six tanks are mounted in framework which provides for overflow and drainage at the top; and through a junction block at the bottom, each tank contains input and output connections, a thermometer outlet and a drain valve. Each tank holds about 3.5 liters.

Pumps. The outgoing solution passes through a thermostat block and is drawn into a diaphragm pump. One wall of the pump chamber provides heat to the solution, under the control of the thermostat, and maintains the solution temperatures within ±1 F. The diaphragm pump returns the solution to the tank through a standpipe located in the tank. The solution is forced out of holes at various levels in the standpipe. The tank film-dividers have large holes which permit the jets of fresh solution to mix thoroughly throughout the tank.

Each pump and its associated heater have ample reserve power to circulate and control the temperature of 40 or more extra liters of solution held in a suitable container, outside the machine. In this manner a large supply of solution for long periods of continuous operation can be stored, and can be replenished while the machine is in operation.

Solution Connections. The tanks are connected to the pumps through rubber tubing. The connections can be altered as desired to permit one or more tanks to be in the same circuit.

Dryer. The dryer unit consists of a blower having a capacity of 300 cu/ft/min, and two pairs of 660-w heaters; one pair has a fixed high-temperature cutout, and the other pair a manually set thermostatic control. On leaving the final wash tank, the film passes through a pair of rubber squeegee rollers and an air knife. When it enters the dryer, the airstream forces it against a moving cloth belt, which blots any remaining water droplets off its rear surface. As it leaves the dryer, the back of the film runs against a flannel cloth.

Fig. 5. Inserting removable film-track divider: Stainless-steel dividers are used to partition the tanks laterally to form one track for 70mm, two tracks for 35mm, or four tracks for 16mm film.

Film Magazine. The film magazine takes a 400-ft film spool or core loading, holding four tracks of 16mm, two of 35mm or one of 70mm. It is light tight.

Power and Water Requirements. The standard machine operates on 110–115 v, 60-cycle, and intermittently draws up to 45 amp, when equipped with four pumps and solution heaters. Machines can be supplied for 220- to 250-v operation on 60- and 50-cycle a-c.

A source of tempered wash water is required. With two wash tanks operating, up to 15 liters of water per minute are required.

Fig. 6. Threading the machine: About 40 in. of film from the magazine is drawn across the steel rollers and attached to the take-up reel. Closing the rubber roller assembly on the film completes the loading operation.

Table I. Mark 3 Processor Performance Data.

Loop Lengths			
Full loop-length in each tank	42 in.		
Number of tanks	6		
Loop length in dryer	54 in.		
Length of film in machine during processing (full loops)	306 in. (25.5 ft)		

Processing Times

	Transport speed, ft/min		
	1.5	3	6
Time per tank (full loop)	140 sec	70 sec	35 sec
Time in dryer	180 sec	90 sec	45 sec
Elapsed time from "Start" until film begins emerging	17 min	8.5 min	4.25 min
Time required to process one 100-ft film length	84 min	42 min	21 min

Table II. Typical Gammas Obtained With Common Films.

Processing Sequence: (1) Two tanks Kodak D-19 Developer; (2) Two tanks Kodak Rapid Liquid Fix (with hardener); (3) Two tanks of wash water.

Film Type	Transport Speed, ft/min	Temp., F	Gamma
Ansco Supreme	1.5	75	0.90
	3	85	0.90
	6	95	0.95
Du Pont 930 A (developed as a negative)	3	85	1.35
	6	95	1.35
	6	105	1.55
Du Pont 931A (developed as a negative)	3	85	1.45
	6	95	1.40
Gevapan 33	3	85	0.90
	6	95	0.85
Kodak Plus-X	3	85	0.80
Tri-X	1.5	75	0.90
	6	95	0.85
	6	105	1.20
Linagraph Shellburst	3	75	1.80
	6	105	2.70

Production Output

Table I gives information on processing times obtained in the Mk3 Tri-Film Processor. Because of its unusual design, there are some aspects of performance which require special note.

Processing with nearly all films is practicable at either 3 ft/min or 6 ft/min, and the lower speed is seldom needed. If four tracks of 16mm are being processed at 6 ft/min, the combined output is, of course, 24 ft/min; two tracks of 35mm film lower this figure to a combined output of 12 ft/min which, however, is quite substantial for a machine of this size.

The absence of a leader aids the production rate of the machine for film up to 100 ft in length, when compared with the output rate of machines requiring a leader. As an example, the Mk3 Processor will produce in a single track, one 100-ft roll in 21 min at a transport rate of 6 ft/min. A hypothetical machine requiring 150 ft of leader would have to operate at 12 ft/min to equal this.

Production Results

The Processor has successfully handled all classes of films except the double-coated x-ray films and a few microfilms which have jet backing (not dyeback). Table II shows the kind of results obtained with a number of typical films.

After more than a year of testing in operational use on a number of projects, we are satisfied that the machine will give controllable processing of consistently good quality, and that it has achieved the aim of its designers.

Conclusion

The value of photographic instrumentation is often hampered by a lack of adequate film-processing equipment suitable for field operation.

In recognition of this situation, the Mk3 Automatic Tri-Film Processor has been designed, and the results of a year's operation have proven very gratifying to both the users and the designers. It is hoped that the Mk3 Processor will prove to be a useful new facility for the science of photographic instrumentation.

Discussion

Robert Polk (Fairchild Camera & Instrument Co.): On the transport and the variable drive, how do you control the speed?

Mr. Ross: That's simply a matter of changing a belt on a pulley. There are the three fixed speeds of $1\frac{1}{2}$, 3 and 6 feet per minute.

John H. Waddell (Session Chairman): Do you have agitation in the developer; and, secondly, have you run into any traces of Eberhard effect, particularly on images which might be as small as 1/1000ths of an inch?

Mr. Ross: First, the solution is returned from the pump through a standpipe located in the side of the tank. The pipe has holes spaced at intervals along it and the solution is jetted out into the main solution under considerable force. It passes through large holes in the dividers, and quite a bit of turbulence takes place as it does so. We haven't run into any difficulties with agitation.

In answer to the second question, we have no evidence of any directional effects in the machine.

A New Shoulder-Mounted Tracking Camera

By A. M. ERICKSON
and C. G. GROVER

This paper describes a new design in shoulder-mounted instrumentation cameras constructed by the Naval Ordnance Laboratory for tracking high-speed, air-laid ordnance. It discusses features required in the tracking problem and compares this camera with earlier models in its ability to provide the facilities required by field evaluation groups.

The problem of devising a satisfactory method for obtaining motion pictures of air-laid ordnance has been given a great deal of study by the Naval Ordnance Laboratory. Two types of such photographs are required: general-information photographs and coordinate or position photographs. Coordinate or position photographs are commonly obtained by cine theodolites of high precision, requiring carefully surveyed target ranges for their operation. The problems involved in this type of photography have been quite generally covered in the literature of this Society.

The general-information picture of a falling missile has by contrast received relatively little attention, perhaps because of the belief that standard photographic methods were adequate to depict it. When the first air-laid mine program was initiated at the Naval Ordnance Laboratory the demand for high-quality motion pictures of the entire drop sequence became acute, and it was immediately evident that conventional methods and equipment would not produce the type of picture that was wanted. At that time experiments were started to improve techniques and equipment for this type of picture.

Presented on May 2, 1957, at the Society's Convention at Washington, D.C., by A. M. Erickson and C. G. Grover (who read the paper), U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.
(This paper was received on May 1, 1957.)

The major problem area was that of tracking mines dropped from low-flying, high-speed aircraft. The photographic techniques initially developed were neutralized as aircraft speeds continued to increase. Today, the tracking problem has taken on a new aspect. Target speeds at close range demand tremendous tracking rates, and radar-controlled or gun-director equipment is completely unsuitable.

Since automatic equipment was not suitable for the job, NOL turned to human engineering in order to continue to record photographically the same event at the new speeds. Our goal was to adapt equipment to the operator in such a way that he could control its position almost as well as his own body. This means that several things must be considered. What is the maximum camera weight? What shape should it be? How should it be attached to the operator? What controls will he need? These and many other questions about the operator's dimensions, his requirements for equipment control and his environment under test conditions had to be answered.

Consider the requirements from the viewpoint of the operator while he is doing the job. All equipment must be carried with him. The observation point is rarely flat ground with no wind. Most mine drops are made over water or at some out-of-the-way location for safety reasons. In many instances the operator must ride a small boat to a position near the expected impact point and take pictures from its rolling deck. To record the full drop he must be ready to aim his camera in any direction from full vertical to below the horizon. A tripod-mounted device is impractical at first glance. The problem basically is to design a man-mounted motion-picture camera.

In our efforts to solve this problem we tried to use many combinations of different commercial cameras. Early attempts were made with standard cameras with lenses up to 6-in. focal length, but the results were disappointing. The next step was a conventional gun-stock type of mount (Fig. 1). This used a Bolex 16mm camera. Electric drive provided ample running time, but the image was too small and the whole instrument was too heavy and poorly balanced for satisfactory operation. Figure 2 shows an improved version using a Cine Special camera, 6× monocular sight and 15-in. lens. Again the awkward balance and heavy weight of the camera made it unsuccessful, although the image size was quite satisfactory.

In the next step (Fig. 3), we see the first basic concept of the shoulder-mounted tracking camera accomplished by shifting the camera back to the operator's shoulder, while still retaining the 15-in. telephoto lens, the magnifying optical sight and Cine Special camera. This unit was used continuously until 1955 and produced a tremendous volume of vital information. Through the years, a number of weak points were brought out in use, and although attempts were made to eliminate them by modifying the unit, too many limitations were imposed by the basic components.

About two years ago work was started

Fig. 1. An early experimental tracking mount built around a Bolex 16mm camera and gunstock.

Fig. 2. A later version utilizing a Cine Special. This typifies the poor balance characteristics of gunstock-type mounts.

Fig. 3. The first camera making use of the shoulder-mount concept. Bulk of the weight is on operator's shoulder.

Fig. 4. The present high-speed shoulder-mounted camera. Camera is perfectly balanced in this position.

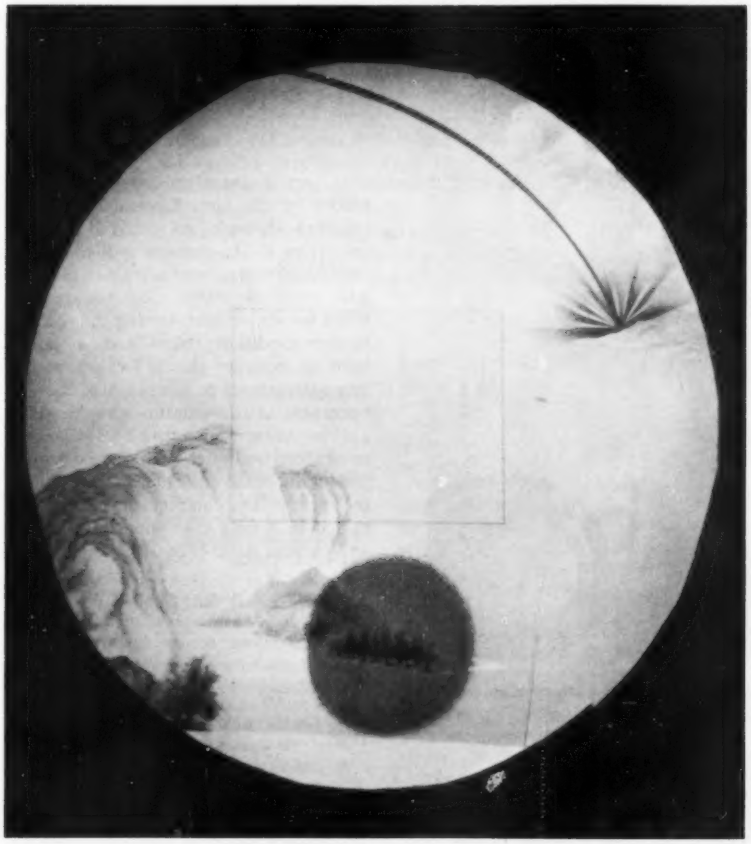


Fig. 7. Field seen through optical sight. The circular ground-glass area below the field line assures critical sharpness when focusing target is available.

Fig. 5. Speed and focus control are centered in the two guiding handles on the front of the mount.

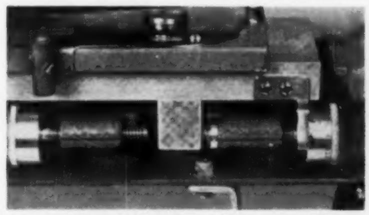


Fig. 6. Short-distance (left) and long-distance (right) focus limit stops, and calibrated focus scale.

on the design of a completely new camera, embracing the basic shoulder-mount feature and incorporating all new features which experience had shown were desirable. Figure 4 is this improved version. As can be seen, the entire weight of the camera is supported on the operator's shoulder, leaving the arms free for one function, that of guiding the camera to follow the missile. Notice how the weight of the camera has been wrapped around, behind and below the operator's shoulder. In a horizontal position the camera is completely balanced. At high elevations it becomes slightly light in front, allowing the operator to relax and use his natural arm weight to maintain equilibrium. This is a further extension of the original shoulder-mount concept which required the operator's arm to support a small portion of the camera weight on extended arms. The stability achieved through balance is fundamental to the successful use of this camera for high-speed, low-altitude tracking by field personnel.

Mechanically, the shoulder mount is a 16mm electrically driven magazine type of camera. Several features are unusual (Fig. 5). Control of the camera is concentrated in two handles at the front of the mount. The operator's right hand controls a two-position trigger switch, giving a choice of 64 or 128 frames/sec. An exposure compensator is available, making it unnecessary to change lens aperture when the speed is changed. The lefthand trigger is the focus control. Prior to actual photography, the operator presets his camera to the shortest and longest distance he wishes to be in sharp focus (Fig. 6). This is done by reference to a calibrated focus scale or by directly focusing some object at an appropriate dis-

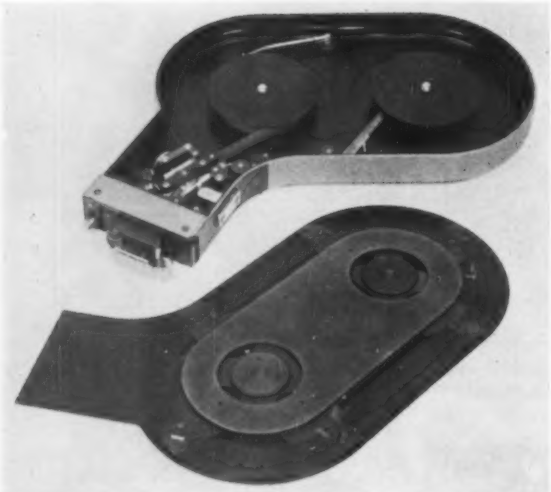


Fig. 8. The 400-ft capacity displacement film magazine with automatic loop formers.

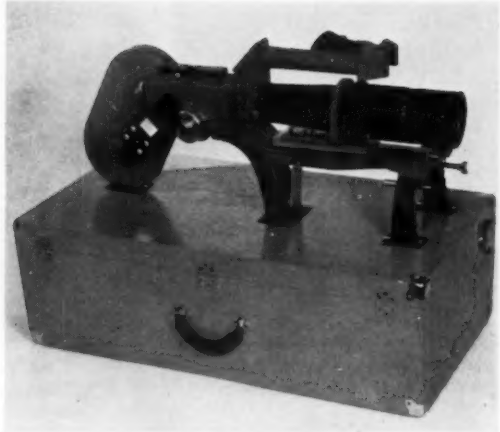


Fig. 10. Camera case doubles as a field stand for the unit. Camera complete weighs 26 lb. Case and control units bring total weight of entire outfit to 74 lb.

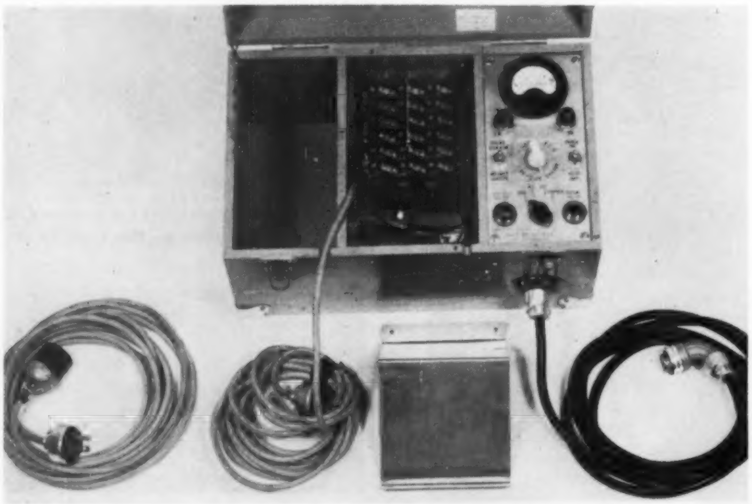


Fig. 9. Field power supply and control unit 30-v nickel-cadmium battery allows for a continuous run of 3000 ft of film at 128 frames/sec.

tance on the circular focusing screen which is seen in the optical sight directly below the field lines (Fig. 7).

The camera now remains focused at the long distance for which it has been preset. Pressure on the focus trigger shifts the point of sharp focus in to the preset short distance. As can be seen, the total field of view of the sight covers approximately six times the area actually recorded on film. This is essential in order to give the operator maneuvering room in tracking the rapidly moving missile. If the missile image goes off the film area he can see his error and correct it before he loses the image in the sight. Optically, the image from the regular photographic objective passes through a beam splitter which reflects a small percentage of the total field of the objective to a reticle which optically appears in precisely the same position as the film emulsion. A telescope system views this reticle and superimposed image and presents a magnified view to the eye in proper orientaton and in the proper position in relation to the rest of the camera to enable the operator to elevate the camera through a 90° arc without losing contact between eyepiece and eye. Overall magnification from lens to eye with a 12-in. lens in place is somewhat greater than that provided by an 8× telescope.

The camera is provided with a removable film magazine (Fig. 8) with a maximum capacity of 400 ft of film. Automatic loop formers assure proper film threading and the timing system allows two separate timing marks to be placed on the film. Electrical power is supplied through an external control unit (Fig. 9). It contains a 30-v nickel-cadmium battery, and a built-in charger with automatic cutoff. Controls are provided for setting and starting the charge, battery-condition tester and a safety light to polarize the 115-v a-c power line with respect to the camera. For a-c operation, the 24-v motor is replaced by a 115-v universal motor. The polarized power lead and safety light insure proper grounding of the camera frame for operator's safety. The complete camera is contained in a field case which also serves as a camera stand (Fig. 10).

(Accompanying this paper at the Convention was a 200-ft motion-picture film containing scenes taken with the NOL shoulder-mounted cameras of air-laid ordnance.)

Discussion

H. C. Schepler (Air Force Armament Center, Eglin AFB, Fla.): A question that frequently comes up in tracking on the ranges is monocular vs. binocular tracking. Have you made any test runs in this regard. I noticed on your first pictures you were using a monocular and if you ran any tests on this what were the results?

Mr. Grover: The original experiments that NOL started with tracking methods made use of monocular sights all the way through; and we found, particularly in finding the missiles before they come into the normal field of view, that most of the operators preferred the monocular type to the binocular. This may be just a matter of personal preference but at the moment it is what we are committed to.

L. A. D. Colvin (Naval Proving Ground, Dahlgren, Va.): Is this camera available — the drawings, etc.? Can other activities either duplicate it or have the camera made by a commercial firm from your drawings?

Mr. Grover: The camera was designed at the Naval Ordnance Lab. and complete production drawings are now being made. They should be available through channels to other activities.

Proposed Bylaw Amendments

THE FOLLOWING proposed amendments to the Society's Bylaws were approved by the Board of Governors on April 28, 1957, with the exception of the revision of Sec. 6 of Bylaw V which was approved at a meeting of the Board held July 12, 1957. These amendments are now ready for consideration by the voting members of the Society.

The proposal will be voted upon at a business meeting scheduled for the opening sessions of the 82nd Convention in Philadelphia on October 4. If approved, the amendments will become effective immediately.

This is the third major revision of the Society's Bylaws since the appointment in 1947 of a Committee on Revision of the Constitution and Bylaws. The first Constitutional Amendment which was approved became effective in 1949 and included a provision for adding "Television" to the name of the Society.

Present members of the Committee are: Wilton R. Holm, Chairman; Herbert Barnett; George H. Gordon; Reid H. Ray; John W. Servies; Ethan M. Stifle; John G. Stott; and Edwin W. Templin.

In proposing changes to the present Bylaws, the Committee aims at clarity, and revisions are based upon careful reappraisals and redefinitions of committee procedures and responsibilities.

The major revisions which are being proposed are with respect to Bylaw V, "Committees." The objective has been to consolidate and redefine in this Bylaw the organization of those Committees which are referred to elsewhere in the Bylaws. Some corollary changes have been necessitated in Bylaws I, VII and VIII.

Provision is made in the proposal for revising Sec. 5 of Bylaw V for a reorganization of the National Admissions Committee, the appointment of Regional Admissions Committees and changes in procedure to conform with the changed committee organization. The objective of the proposed amendment is to secure increased uniformity and coordination in the review of membership applications. In this connection it is proposed to change Sec. 3 (f) of Bylaw VII to place Admission activities under the general supervision of the Sections Vice-President.

Another proposed change for the purpose of clarification transfers the provisions for the Nominating Committee from Sec. 1, Bylaw VIII, to Sec. 7, Bylaw V.

Another important proposed change is made in the appointing procedures for the Executive Committee provided for in the present Sec. 7 of Bylaw V which will be designated Sec. 8 if the above noted change is approved. Under the present provisions of this Bylaw the requirements for organization of the Executive Committee are such that it might well be rendered incapable of operating should the Officers who are proscribed as its members be elected from geographically widely separated points. The proposed revision, by increasing the latitude of the President in appointing members, permits selection of Officers who will be able to attend the frequent meetings of this committee.

BYLAW I

Membership

Sec. 3 (c). An applicant for Active membership shall give as reference at least one member of the grade applied for, or of higher grade. Applicants shall be elected to membership by a three-fourths majority of the appropriate Admissions Committee. Applications for admission or transfer of grade, upon which the appropriate Regional Admissions Committee takes adverse action, will be referred to the National Admissions Committee. A four-fifths majority vote of the National Admissions Committee shall be required to change the action of a Regional Admissions Committee. An applicant or his sponsor may appeal to the Board of Governors if not satisfied with the action of the National Admissions Committee, in which case approval of at least three-fourths of those present at the meeting shall be required to change an action taken by the National Admissions Committee.

BYLAW V

Committees

Sec. 1. All Committees, except as otherwise specified, shall be formed and appointed in accordance with the Administrative Practices.

Sec. 2. (No change).

Sec. 3. (No change).

Sec. 4. There shall be an Honorary Membership Committee consisting of five Honorary, Fellow or Active members of the Society.

Sec. 5 (a). There shall be Admissions Committees for the Society as follows: (1) Regional Admissions Committees, designated Western, Central, Eastern and International, with jurisdictions as defined by the Administrative Practices. Each Regional Admissions Committee shall consist of a chairman and three members of Active or higher grade. (2) A National Admissions Committee composed of a chairman and four members, one from each of the Regional Committees.

(b) The Chairman of the National Admissions Committee shall be appointed by the Sections Vice-President. He shall report to the Sections Vice-President.

(c) The Chairman of the Regional Committees shall be appointed by the National Admissions Committee Chairman with the approval of the Sections Vice-Pesident. They shall report to the National Admissions Chairman.

(d) It shall be the duty of each Regional Admissions Committee to process applications for membership and for transfer between membership grades, within the jurisdiction of said committee in accordance with the Constitution, the Bylaws and the Administrative Practices of the Society.

(e) It shall be the duty of the National Admissions Chairman to guide, review and coordinate the action of the Regional Admissions Committees in order to administer the provisions of Sec. 1, Bylaw I, relative to requirements for admission to membership or for transfer between membership grades.

Sec. 6. There shall be a Fellow Award Committee composed of all the officers and Section Chairmen of the Society, together with the Chairmen of the Engineering Committees. The Past-President of the Society shall be the Chairman of the Committee. In case the Chairmanship is vacated it shall be temporarily filled by appointment by the President.

Add: **Sec. 7.** There shall be a Nominating Committee appointed by the President, consisting of nine members including a Chairman. The Committee shall be made up of two Past-Presidents, three members of the Board of Governors not up for election, and four other voting members, not currently officers or governors of the Society.

Sec. 8. There shall be an Executive Committee to review regularly the operations of the Society, plan the forthcoming budget, and carry out assignments of the Board of Governors. The Chairman of this Committee shall be the President or the Executive Vice-President, whichever resides in the vicinity of the executive offices. There shall be three other members appointed by the President from among the other officers of the Society. The membership of the Executive Committee shall be approved by the Board of Governors.

BYLAW VII

Sec. 3 (f). The Sections Vice-President shall coordinate and be responsible for administration of the affairs of Sections and Student Chapters and shall help these groups by interpreting Society policy and assisting in the planning of meetings. He shall also aid in the formation of new Sections and Student Chapters. He shall be responsible for the general supervision and coordination of the work of the Admissions Committees.

BYLAW VIII

Sec. 1. All officers and governors shall be elected to their respective offices by a majority of ballots cast by voting members in the following manner:

Nominations shall be presented by a Nominating Committee. Nominations shall be made by three-quarters affirmative vote of the total Nominating Committee.

(*No changes in subsequent paragraphs.*)

American Standard

16-Tooth 35mm Motion-Picture Projector Sprockets

ASA
Reg. U.S. Pat. Off.
PH22.35-1957
Revision of Z22.35-1947
*UDC 778.55

Page 1 of 2 Pages

1. Scope

1.1 This standard is applicable to sprockets used in conjunction with 35mm motion-picture film perforated in accordance with either American Standard Dimensions for 35mm Motion-Picture Film, Alternate Standards for Either Positive or Negative Raw Stock, PH22.1-1953, or Dimensions for 35mm Motion-Picture Positive Raw Stock, PH22.36-1954, or the latest revisions thereof approved by the American Standards Association, Incorporated.

1.2 This standard is limited to sprockets employed in the picture projection mechanism.

2. Definitions

2.1 *Feed Sprocket.*—A feed sprocket is a sprocket which pulls the film against tension. It originally applied to the upper sprocket in the projector.

2.2 *Hold-Back Sprocket.*—A hold-back sprocket is a sprocket which holds back the film against tension. It originally applied to the lower sprocket in the film take-up section of the projector. In many present-day projectors the sprocket occupying this lower position no longer has the hold-back function and is, instead, an idler sprocket.

2.3 *Idler Sprocket.*—An idler sprocket is a sprocket which neither pulls nor holds back film against tension. It is normally used to maintain a film loop.

2.4 *Intermittent Sprocket.*—An intermittent sprocket is a feed sprocket employed to advance the film one frame at a time past the picture aperture at the designated frame rate.

3. Dimensions

3.1 The sprocket dimensions shall be as given in the diagram and table provided.

	Feed Sprocket		Intermittent Sprocket		Hold-Back Sprocket	
	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
A	1.097 ± 0.001	27.86 ± 0.03	1.097 ± 0.001	27.86 ± 0.03	1.097 ± 0.001	27.86 ± 0.03
†B						
C	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$
D	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$	$0.055^{+0.000}_{-0.002}$	$1.40^{+0.00}_{-0.05}$
E	22 degrees 30 min ± 1.5 min		22 degrees 30 min ± 0.75 min		22 degrees 30 min ± 1.5 min	
Suggested Dimensions						
r	0.077	1.96	0.077	1.96	0.077	1.96
s	0.004	0.10	0.004	0.10	0.004	0.10
t	0.935	23.75	0.935	23.75	0.922	23.42
u	0.139	3.53	0.139	3.53	0.139	3.53
v	0.040	1.02	0.040	1.02	0.040	1.02
w	1.045	26.54	1.045	26.54	1.032	26.21

† This dimension varies in commercial practice from 0.935 in. to 0.950 in. for the feed and intermittent sprockets. Manufacturers have discovered that this dimension may appreciably affect the projector noise level. The choice of an optimum value is somewhat empirical in nature and appears to be influenced by tooth design, the degree of film wrap and the amount of film tension. When film life is of the greatest importance, dimension 0.950 in. should be chosen. For hold-back sprockets, this dimension varies in commercial practice from 0.932 in. to 0.940 in. Good practice requires that the pitch of a hold-back sprocket be less than the pitch of the film.

‡ The accumulated error between any 2 teeth shall not exceed 4 min.

Approved June 26, 1957 by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

* Universal Decimal Classification

Printed in U.S.A.
ASA 3/4M857

Price, 25 Cents

American Standard

Projected Image Area of 8mm Motion-Picture Film

ASA
Reg. U.S. Pat. Off.
PH22.20-1957
Revision of Z22.20-1950
*UDC 778.55

Page 1 of 2 Pages

1. Scope

1.1 This standard specifies for 8mm motion-picture projectors the image to be projected and the relative positions of the aperture producing this image, the edge guide and the film registration device.

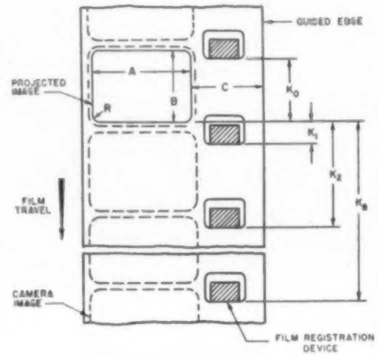
1.2 The notes are a part of this standard.

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

2.2 The angle between the vertical edges of the image and the edges of normally positioned film shall be $0° \pm 1/2°$.

2.3 The angle between the horizontal edges of the image and the edges of normally positioned film shall be $90° \pm 1/2°$.



DRAWING SHOWS ARRANGEMENT AS SEEN FROM INSIDE PROJECTOR LAMPHOUSE LOOKING TOWARD THE LENS

Dimensions	Inches	Millimeters
A	0.172 ± 0.001	4.37 ± 0.03
B	0.129 ± 0.001	3.28 ± 0.03
C	0.119 ± 0.002	3.02 ± 0.05
K_0	0.114 ± 0.005	2.90 ± 0.13
K_1	0.035 ± 0.005	0.89 ± 0.13
K_2	0.184 ± 0.005	4.67 ± 0.13
K_3	0.333 ± 0.005	8.46 ± 0.13
K_4	0.482 ± 0.005	12.24 ± 0.13
K_5	0.631 ± 0.005	16.03 ± 0.13
K_6	0.780 ± 0.005	19.81 ± 0.13
K_7	0.929 ± 0.005	23.59 ± 0.13
K_8	1.078 ± 0.005	27.38 ± 0.13
R	0.010 max	0.25 max

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Printed in U.S.A.
ASA 3/4M857

Price, 25 Cents

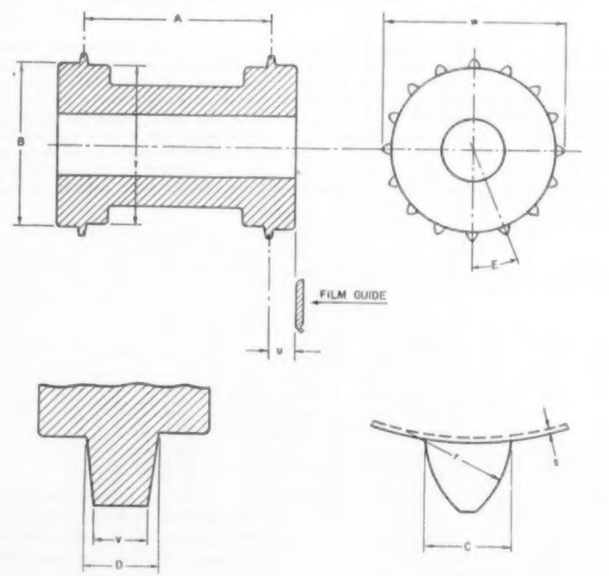
Four American Standards

Published here are American Standards PH22.8-, PH22.20-, PH22.35- and PH22.41-1957 which were approved by the American Standards Association on June 26, 1957.

PH22.8, Projected Image Area of 16-mm Motion-Picture Film, and PH22.20, Projected Image Area of 8mm Motion-Picture Film, are revisions of the 1950 standards Z22.8 and Z22.20. Subsequent to their trial publication in the May 1956 *Journal*, a modification of both standards was proposed and approved and is incorporated in these final versions. This change involved the deletion of the side view in the diagram indicating the D value as a relationship of the film to the aperture plate. Inasmuch as D is a dimensionless value, a note is included in the standard which states that "This separation should be no larger than is necessary to preclude scratching of the film."

PH22.41, a revision of Z22.41-1946, also had its trial publication in the May 1956 *Journal*. The final version remains the same as that published for trial and comment.

PH22.35, a revision of Z22.35-1947, had its trial publication in the September 1955 *Journal*, and has been adopted as an American Standard without change since the trial publication.—*J. Howard Schumacher*, Staff Engineer.



NOTE: When a sprocket is acting as an idler the value of dimension B depends on the particular design of the projector. The range for this dimension in commercial practice is 0.937 in. to 0.950 in.

PH22.35-1957

NOTES

1. Dimensions A, B and R apply to the portion of the image on the film that is to be projected; the actual opening in the aperture plate has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation of the emulsion and the physical aperture. To minimize the difference in size and make the image of the aperture as sharp as practicable on the screen, this separation should be no larger than is necessary to preclude scratching of the film. When the reduction in size from the image to the actual aperture is being computed, it is suggested a 1-in. f/1.6 lens be assumed unless there is reason for doing otherwise.

2. The limiting aperture is usually between the film and the light source so that it will give the maximum protection from heat. If other factors are more important, it may be on the other side of the film.

3. In 8mm projectors the edge guide should bear on the edge of the film adjacent to the perforations. The other edge of the film usually is slit after processing and so is more likely to weave laterally with respect to the pictures.

The value of dimension C has been chosen so that film having a slight shrinkage when it is projected will be properly centered. This is the normal condition.

4. The K dimensions are measured along the path of the film from the bottom of the image area formed on the film by the aperture to the stopping position of the registration device. It is customary to provide a framing movement of approximately 0.025 in. above and below this nominal position. For any given projector, use the value of K corresponding to the location of the registration device.

If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary.

PH22.20-1957

American Standard

Photographic Sound Record on 16mm Prints

ASA
Reg. U.S. Pat. Off.
PH22.41-1957
Revision of Z22.41-1946
*UDC 778.534.4

1. Scope

1.1 This standard specifies the location and dimensions of variable-area and variable-density sound records for the photographic printing of sound on 16mm motion-picture film perforated along one edge. Also specified is the area scanned in the sound reproducer.

1.2 The notes are a part of this standard.

2. Dimensions

2.1 The dimensions and location of the sound record shall be as specified in the diagram and table.

2.2 The sound record as printed on the film shall be displaced from the center of the corresponding picture by a distance of 26 frames ± ½ frame in the direction of film travel during normal projection.

Dimensions	Inches	Millimeters
A	0.018 max	0.46 max
B	0.110 max	2.79 max
	0.098 min	2.49 min
C	0.060 +0.006 −0.001	1.52 +0.15 −0.03
D	0.058 ± 0.002	1.47 ± 0.05
E	0.080 ± 0.001	2.03 ± 0.03
F	0.058 ± 0.001	1.47 ± 0.03
G	0.072 max	1.83 max
	0.070 min	1.78 min

NOTES

1. Where the original sound record has been reduction printed in some stage of the process, it may be impossible to obtain the black septum on either side of the record area. The presence of a clear septum between the sound and picture areas which does not encroach on the minimum tolerances of the printed area shall not be a basis for the rejection of prints. Shaded septum areas are intended to include all unused areas on both sides of the sound record, up to the picture on one side and up to the film edge on the other.

2. Dimension C is based on present-day equipment design. It is recommended that all future equipment be designed for a record width of 0.060 ± 0.001 in. and that existing equipment be modified to produce prints having dimension C as close as practicable to 0.060 ± 0.001 in.

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Sponsor: Society of Motion Picture and Television Engineers

* Universal Decimal Classification

Price, 25 Cents

American Standard

Projected Image Area of 16mm Motion-Picture Film

ASA
Reg. U.S. Pat. Off.
PH22.8-1957
Revision of Z22.8-1950
*UDC 778.55

1. Scope

1.1 This standard specifies for 16mm motion-picture projectors, employing 16mm film perforated along either one or both edges, the image to be projected and the relative positions of the aperture producing this image, the edge guide and the film registration device.

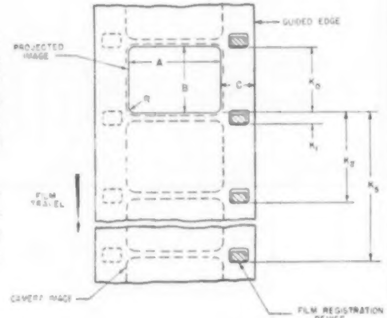
1.2 The diagram illustrates film with perforations along both edges. When single-perforated film is used, the perforations appear only on that edge of the film that bears against the fixed guides.

1.3 The notes are a part of this standard.

2. Dimensions

2.1 The dimensions shall be as specified in the diagram and table.

2.2 The angle between the vertical edges of the image and the edges of normally positioned film shall be 0° ± ½°.



DRAWING SHOWS ARRANGEMENT AS SEEN FROM INSIDE PROJECTOR LAMPHOUSE LOOKING TOWARD THE LENS

2.3 The angle between the horizontal edges of the image and the edges of normally positioned film shall be 90° ± ½°.

Dimensions	Inches	Millimeters
A	0.380 ± 0.002	9.65 ± 0.05
B	0.284 ± 0.002	7.21 ± 0.05
C	0.124 ± 0.002	3.15 ± 0.05
K_0	0.266 ± 0.005	6.76 ± 0.13
K_1	0.032 ± 0.005	0.81 ± 0.13
K_2	0.330 ± 0.005	8.38 ± 0.13
K_3	0.628 ± 0.005	15.95 ± 0.13
K_4	0.926 ± 0.005	23.52 ± 0.13
K_5	1.224 ± 0.005	31.09 ± 0.13
R	0.020 max	0.51 max

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Price, 25 Cents

NOTES

1. Dimensions A, B and R apply to the portion of the image on the film that is to be projected; the actual opening in the aperture plate has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation of the emulsion and the physical aperture. To minimize the difference in size and make the image of the aperture as sharp as practicable on the screen, this separation should be no larger than is necessary to preclude scratching of the film. When the reduction in size from the image to the actual aperture is being computed, it is suggested a 2-in f/1.6 lens be assumed unless there is reason for doing otherwise.

2. The limiting aperture is usually between the film and the light source so that it will give the maximum protection from heat. If other factors are more important, it may be on the other side of the film.

3. The K dimensions are measured along the path of the film from the bottom of the image area formed on the film by the aperture to the stopping position of the registration device. It is customary to provide a framing movement of 0.025 in. above and below this nominal position. For any given projector, use the value of K corresponding to the location of the registration device.

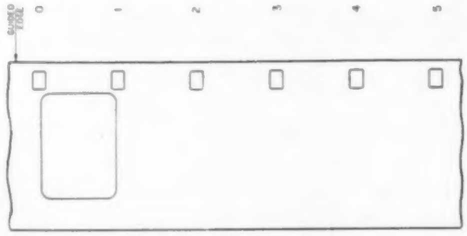
If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary.

APPENDIX

(This Appendix is not a part of the American Standard Projected Image Area of 16mm Motion-Picture Film, PH22.8-1957, but is included to facilitate its use.)

Perforation 3 in the diagram is suggested as the preferred location for vertical registration, since it is the perforation used in the numerically largest group of 16mm cameras. This location is desirable unless another position is necessary because of the requirements of special-purpose equipment or a sprocket type of pulldown mechanism.

If perforation 3 is used for vertical registration, good kinematic design points to the location of the edge guiding means at points opposite perforations 0 and 3.



PH22.8-1957

SMPTE Recommended Practice Approved

The proposed SMPTE Recommended Practice, Lens Mount Surface, High-Speed Motion-Picture Cameras, published in the March 1957 *Journal* for trial and comment, was approved without change by the Society's Board of Governors on July 12, 1957 at its quarterly meeting.

A copy of this Recommended Practice may be obtained without charge upon request directed to *J. Howard Schumacher*, Staff Engineer, at Society Headquarters.

SMPTE RECOMMENDED PRACTICE

Lens Mount Surface High-Speed Motion-Picture Cameras

INTRODUCTION

This Recommended Practice originated in the Lens Mount Subcommittee of the High-Speed Photography Committee. It was approved by the High-Speed Photography and Standards Committees and was published in the March 1957 *Journal*. The recommendation received final approval by the SMPTE Board of Governors on July 12, 1957.

RECOMMENDATION

1. *Scope*

1.1 This recommendation specifies for high-speed motion-picture cameras the surface for mounting lens adapters.

2. *Lens Mount Surface*

2.1 High-speed motion-picture cameras shall have a machined plane surface for mounting lens adapters.

2.2 Data shall be supplied with each camera locating the mechanical and optical distance from this machined surface to the plane of the film.

2.3 Data shall also be supplied for locating the lens mount radially and for attaching the lens adapter.

news and reports

82d Convention – Philadelphia – October 4–9

Papers Program

A wide range of interests will be reflected in the Papers Program which is taking shape under the direction of Program Chairman Deane R. White.

A very timely session in which considerable interest has been expressed will be on bilingual films and international television. This session is tentatively set for Tuesday evening, October 8. Three sessions on high-speed photography are planned to begin Tuesday afternoon and continue all day Wednesday.

An important subject today is the military uses of television, to be considered on Monday afternoon. A series of papers on video tape recording is planned for Saturday afternoon. Other sessions will deal with motion-picture laboratory practices, closed-circuit television, large-screen television and television operating practices.

One important field in which significant work is being carried on is that of the use of color. A number of interesting papers on color for both motion pictures and television are to be included in the program. Plans of the Society's Historical and Museum Committee are described separately below.

During the Convention there will be a considerable schedule of Engineering and Administrative Committee Meetings.

General registration for the Convention will begin on Thursday, October 3, at 2:00 P.M. in the Third Floor Assembly area of the Sheraton Hotel.

Later Convention Information

At the middle of this month a postal folder will be sent to each Society member to give him:

A tentative roster of session subjects and dates,

A tentative schedule of committee meetings,

The Sheraton Hotel rates and reservation card,

A card to enable members to register ahead of time and buy tickets, for economy's sake.

The Advance Program, with abstracts of the papers, is to appear in the September issue of this *Journal*.

Awards Presentations

On Friday evening, October 4, the Society will fulfill one of its most gratifying responsibilities: recognition of contributions in the areas of the Society's interests. These awards are: Journal, Progress Medal, Samuel L. Warner Memorial, David Sarnoff Gold Medal, Herbert T. Kalmus Gold Medal, and Fellowship in the Society.

A special feature of this evening's program will be provided by Dr. Filmore Park of the National Research Council of Canada. He will present the timely subject of "Photography and the IGY."

Get-Together Luncheon

Scheduled for Noon, Friday, October 4, in the East Ballroom — the Luncheon Speaker will be Theodore A. Smith, Executive Vice-President, Industrial Electronics Products, Radio Corp. of America. Mr. Smith has a wide background in motion pictures and television. He is in close touch with new developments in electronics and in his talk will discuss some of the significant research that is now being carried on.

Just for Fun

The traditional "fun" program planned especially for the ladies will include entertainment of special appeal for the chic and modern-minded SMPTE wives — for example, the Tea and Fashion Show at Philadelphia's famous department store, Strawbridge and Clothier — but some of the extracurricular activities will have a more serious aspect, mingling instruction and sentiment with diversion in the tours to the historical spots in and near Philadelphia.

General Registration begins on Thursday, October 3 (2 to 5 P.M.), in the Third Floor Assembly Room. The Ladies Hospitality Headquarters will be open in Parlor D during the same hours and thereafter during the Convention to offer information, suggestions and help with the arrangements.

Among the main events planned for the entertainment of members, wives and guests are the local historical tours, the Valley Forge tour and theatrical and sports activities tentatively scheduled for Sunday, October 6. Plans for Sunday evening include a reception, buffet supper and dance at luxurious Cherry Hill Inn. This pleasing prospect, however, is only the curtain-raiser for the main "fun" event which will occur Monday night, beginning at 6:45 P.M. with the cocktail party and continuing with the semiannual banquet and dance in the Grand Ballroom.

Among the varied events now planned for the Ladies Program are the Tea and Fashion Show scheduled for Friday, October 4, from 3:30 to 5:00 P.M.; a tour to New Hope, Pa., which will include a luncheon at historic Bucks County Inn; an historical tour planned for Monday; and a trip to Winterthur Museum, Wilmington, Del., on Tuesday.

The seven days of the Convention will finish on Wednesday, October 9, with a farewell Punch Party in the afternoon.

The Fall Convention and the Historical and Museum Committee

Our Committee was not sufficiently organized so that the members could be listed in the April Membership Directory. Planning and organizing, particularly at a meeting during the Spring Convention in Washington, enable your Chairman to report on some plans and to announce the Committee's roster:

Walter Clark
James W. Cummings
E. W. Kellogg
Don G. Malkames
S. G. Rose
Malcolm G. Townsley
A. F. Victor

The Committee is endeavoring to present at the Philadelphia Convention:

An exhibit of a few pieces of historical equipment, if proper arrangements can be made with private owners and/or museums. Particular effort is being made to secure the loan of early Lubin equipment which had its origin in Philadelphia.

An historical motion picture to be shown with a member of the committee acting as narrator.

A paper to be presented by a member of the committee, the subject to be chosen by the author, but possibly on methods of preserving historic records and equipment.

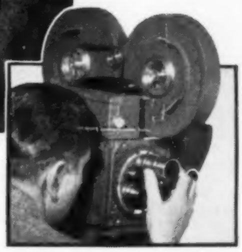
The Committee is also at work on reports for the *Journal*, hoping to cover at least these:

A list of references on outstanding articles on motion-picture and television history published during the preceding years, including articles in foreign publications.

A report on living and passed pioneers, the report to include a brief description of their early work, present whereabouts and biographical data, especially those whose work is unpublished and who, in the opinion of the Committee, have not received due recognition.

A report on historical equipment now in museum and private collections, and a summation of the Committee's effort toward cataloging the existing collections as an aid to future research.

Your Committee will welcome suggestions or possible contributions to its program.—*John B. McCullough*, Committee Chairman, c/o Motion Picture Association of America, 28 West 44th St., New York 36.



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- ★ $1,497.00 list... for Auricon Pro-600 "Double-System" professional picture-camera with built-in features. Also available at added cost is "Single-System" equipment for Optical Sound-Track-On-Film, "C-mount" Lenses, View-Finders, Film Magazines, 3-Lens Turret, Critical Ground-Glass Focusing, Lens Sun-Shades, Tele-Finders, etc...
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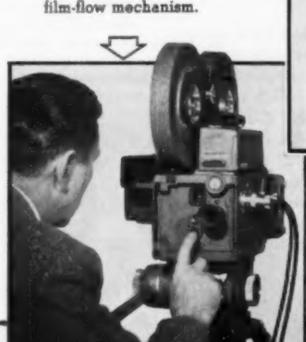
Write for free illustrated "Auricon Pro-600" literature and price schedule.

Auricon Hollywood

"Auricon Pro-600" features Push-Button "On-Off," with safety-interlocked film-flow mechanism.



"Auricon Pro-600" Turret Model with "Zoom" type Lens and Finder in use.

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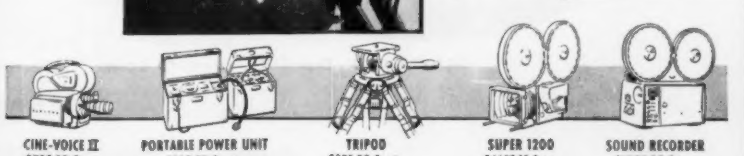

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Industry, Education News

New York Chapter SPSE

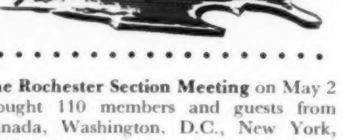
The first meeting of the Board of Directors of the New York Chapter of the Society of Photographic Scientists and Engineers was held on July 1. It was also the last meeting of the Directors of the New York Chapter of the Society of Photographic Engineers and of the Executive Committee of the New York Technical Section of the Photographic Society of America — the two groups whose members are now combined in the newly reconstituted organization. The new New York Chapter's headquarters have been established at 30 East 60 St., New York 22.

Officers of the new Chapter are: President, Henry M. Lester; Programs Vice-President, Henry Croix; Membership Vice-President, Richard Van Steenburg; Editorial Vice-President, Eugene Ostroff; Secretary-Treasurer, Ralph Baum. Members from this area for the national SPSE Board are: Jerome F. Goldhammer, Norman C. Lipton and Lloyd E. Varden.

The first meeting of the Chapter will be held on September 30 in the Engineering Societies Bldg., 29 West 39 St., New York. Dr. John Eggert of the Photographischer Institut of Zürich will be the speaker.

A $15 million TV film production program for the coming year and a $1 million dollar building program to accommodate expanding TV activities were announced recently by Jack L. Warner, President of Warner Bros. Four shows to be telecast over the ABC-TV network are scheduled, the first to be released in September. The four shows now in production and their sponsors are: "Cheyenne," General Electric; "Sugarfoot," American Chicle Co.; "Maverick," Kaiser Industries; and "Colt 45," Campbell Soup. Plans have been completed for the new building and construction will begin soon. The 2-story building is 135 by 240-ft and houses 26 office suites, 26 film editing rooms and 4 projection rooms.

section reports



The Rochester Section Meeting on May 2 brought 110 members and guests from Canada, Washington, D.C., New York, Pittsburgh and Rochester to attend the half-day symposium on Black-and-White Process Control at the Powers Hotel, Rochester, N.Y.

A distinguished roster of speakers included Ethan M. Stifle, SMPTE Sections Vice-President who gave the welcoming address. Other speakers and their topics were: "Background for the Application of Quality Control Methods" by M. G. Anderson of Ansco, Binghamton, N.Y.; "Application of Quality Control Methods to Motion-Picture Film Processing" by Allan M. Koerner of Eastman Kodak Co., Rochester, N.Y.; "Process Control as Applied in a Large Laboratory" by Albert A. Duryea of Consolidated Film Industries, Fort Lee, N.J.; "Process Control as Applied in a Smaller Laboratory" by Paul S. Peters of MPA-TV Film Productions, Inc., New Orleans, La.; "Sensitometers" by Oran E. Miller of Eastman Kodak Co., Rochester, N.Y.; "Densitometers" by Stanley A. Powers of Eastman Kodak Co., Rochester, N.Y.; and "Chemical Control in Processing Operations" by Lloyd E. West, Eastman Kodak Co., Rochester, N.Y.

The Symposium was closed by a panel discussion participated in by all the speakers.

The entire program was tape recorded and tapes are available on loan.

The Symposium Committee was composed of General Chairman, Walter I. Kisner; Program Chairman, George T. Negus; Reception, John W. Zuidema, Nicholas H. Groat and William R. Weller; Publicity, Thomas W. Hope; Projection, Roland E. Connor and Gordon H. Tubbs; Registration and Membership, Jasper S. Chandler; Dinner and Refreshments, Raymond De Moulin—*A. E. Neumer*, Secretary-Treasurer, 147 Dale Rd., Rochester 10, N.Y.

The Canadian Section met on June 8 at the National Film Board Auditorium, Toronto with an attendance of 45. Speakers were Barry Gordon of the Canadian Broadcasting Corp. who spoke on the Standardization of Laboratory Techniques in Canada; and Ivor Lomas of Graphic

Films, Ottawa, who spoke on Sensitometric Control. A wide cross-section of the Canadian motion-picture and TV industries was represented at the meeting. Following the papers, a panel discussion was held, covering various aspects of laboratory techniques and the effects on motion-pictures and TV.

Panel members were: Gerald G. Graham, National Film Board, Montreal; Findlay J. Quinn, Trans-World Film Lab., Montreal; Henry C. Ballow, Canadian Kodak Co. Ltd., Toronto; Jim Bach, Cinesound, Toronto. Panel Chairman was Rodger Ross of CBC.

As a result of the interest developed by the discussion it was decided to form a committee to investigate possible acceptable standards with a view to applying suitable standards to Canadian motion-pictures and TV. Committee Chairman will be Rodger Ross. Members will include laboratory technicians, producers, advertising agencies, sponsors, manufacturers and owners and executives of TV stations.—*R. E. Ringler*, Secretary-Treasurer, c/o Du Pont Co. of Canada, 80 Richmond St. W., Toronto.

The Hollywood Section met on June 18 at the Walt Disney Studio, Burbank, Calif., with an attendance of approximately 375. John Stott and John Turner of Eastman Kodak Co., Rochester, N.Y., presented papers on the two phases of printing motion-picture films immersed in liquids to minimize scratches and abrasions. These papers were followed by excellent demonstration films made by this printing method. The films were compared with prints made from scratched negatives on conventional contact and optical printers.

Mort Zimmerman, President of Electron Corp., Dallas, Tex., discussed and demonstrated an inexpensive vidicon camera that can be connected directly onto a home television receiver to form a closed-circuit TV system. This camera will be marketed as a complete unit, or in kit form, to be assembled by the purchaser.

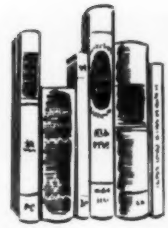
Ralph S. Swanson, Polaroid Corp., described the new Polaroid-Land system of making transparency slides in either $2\frac{1}{4}$ by $2\frac{1}{4}$ or $3\frac{1}{4}$ by 4 size. This system has a speed of 1000 ASA, is panchromatic and produces a virtually grainless image.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The San Francisco Section met June 12 at the Lenkurt Electronics Corp., San Carlos, Calif., with an attendance of 19. Members and guests were taken on a tour of the plant. The company, which designs and manufactures carrier systems, is currently producing several systems for both wire and microwave transmission. Special miniaturized units have been developed for the Army. The tour covered the toroid coil-winding department, capacitor winding, multisecondary transformer winding, cable form fabrication, and the final assembly department.

Scott Robertson of the Lenkurt Electronics Corp. spoke on "The Growth of Lenkurt," and Bill Veideman, of the same firm, described "Lenkurt's Equipment." Before the tour, the group was shown a video recording of a TV show, produced at the plant and showing the plant's operations.—*Werner H. Ruhl*, Secretary-Treasurer, 415 Molimo Dr., San Francisco.

The San Francisco Section met July 9 at the Lockheed Aircraft Co., with an attendance of 38. Two speakers, Myron Baldwin of Beckman-Whitley Co. and Ernest Barkofsky of Lockheed Aircraft Co. spoke on "High-Speed Photography From Rockets." Mr. Baldwin described the Beckman Framing Camera Model 189 which takes 25 frames at from 48,000 to 4,300,000 frames/sec. The image of the subject matter is focused on a turbine-mirror through a highly corrected 24-in. achromate. The image on the mirror is relayed 1 to 1 to the film plane on a 30-in. radius through 25 pairs of adjustable achromates. The mirror is spun by an air- or helium-driven turbine from 7,000 to 18,000 rev/sec. A series of slides made with one of the framing cameras was shown following the talk.

Mr. Barkofsky gave an introduction to a film made by Lockheed for the Society's 1956 Fall convention in Los Angeles. The film showed shots from rockets during take-off and flights. It also showed how a film is recovered and assembled using frame numbers as guides. A film made by Wollensak with a Fastax camera was also shown. This film demonstrated various subjects photographed in the 3,000 to 4,000 frames/sec field.—*Werner H. Ruhl*, Secretary-Treasurer, 415 Molimo Dr., San Francisco 27.



books reviewed

An Introduction to Junction Transistor Theory

By R. D. Middlebrook. Published (1957) by John Wiley & Sons, 440 Fourth Ave., New York 16. i–xxiv + 296 pp. illus. 6 by 9-in. Price $8.50.

(*Edit. Note: A paper by Dr. Middlebrook, to introduce a group of papers on the transistor in the June 1957 Journal, was drawn in part from this book, with the kind permission of the publishers.*)

From the standpoint of a student or engineer first studying transistor theory, this is the most useful book published to date. Many who have taught this subject may disagree in part with the organization and emphasis. Considering the date of publication, there were a number of significant omissions.

Apparently intended primarily for undergraduate instruction, the book begins with a qualitative description of the transistor field and of transistor action. In the transistor theory, the analysis of the diode and the transistor by Shockley and his successors is reviewed and explained in detail. The two terminal pair equations derived in this section are then transformed into an equivalent circuit which Professor Middlebrook has developed. A 24-page concluding chapter discusses collector leakage, surface recombination effects, and the variation of alpha with emitter current analyzed by Webster. The book is profusely illustrated with one drawing for every two pages.

It seemed to me that the diode could be presented more effectively if the reverse bias condition were discussed prior to the forward bias. The diode might also have been used to a greater extent to clarify the basic ideas in transistor action. More emphasis could well have been put on the powerful and essential concept of electrical neutrality. Diffusion flow of carriers, an idea generally unfamiliar to electrical engineers, could be explained convincingly with a simple diagram.

It was a little surprising to find no mention of the Moll-Ebers equations or of avalanche multiplication. Very little is said of Pritchard's work on a-c current distributions in grown triodes.

Professor Middlebrook has thoughtfully included at the front of his book a list of symbols identifying the section in which each symbol is defined.—*J. M. Early*, Bell Telephone Laboratories, Murray Hill, N.J.

The Active-Networks issue of the *IRE Transactions in Circuit Theory* to be published in September 1957 will contain more than a

dozen papers by authorities on various aspects of active networks. In addition, the issue will contain many of the papers given at the Conference on Transistor and Solid-State Circuits held in Philadelphia, February 1957. It is priced at $3.75 a copy for IRE members and libraries. The price to nonmembers is $7.50 a copy. It may be ordered from IRE headquarters, 1 E. 79 St., New York 21.

Storage and Preservation of Motion Picture Film is a new publication issued by Eastman Kodak Co., Motion Picture Film Dept., Rochester 4, N.Y. The 80-page illustrated booklet contains comprehensive storage information for all types of motion-picture film, not only for raw stock but also for processed film. Although the illustrations show 35mm film, the information applies to 16mm and other widths of motion-picture film as well.

The booklet is divided into sections which take up such topics as: The Film; Storage of Raw Film; Handling Film in Laboratories and Storage Centers; Storage and Preservation of Processed Film; Commercial Storage of Processed Acetate Film; Archival Storage of Processed Acetate Film; Storage of Processed Nitrate Film.

The Appendixes include descriptions of Laboratory Tests for Identifying Acetate and Nitrate Film; Proposed American Standards for Photographic Films for Permanent Records; Tests for Unstable Nitrate Film; Method of Desiccating Film.

The booklet is priced at 50 cents.

Photographic Abstracts 2d Decennial Index - 1931-40

By The Scientific and Technical Group. Published (1956) by the Royal Photographic Society of Great Britain, 16 Princes Gate, London S.W.7. 209 pp. Hard-bound. 6¼ × 9¾ in. Price £2 ($5.60).

Very few individuals have unlimited access to the entire literature of an industry. The average person probably has access only to trade journals, semitechnical publications and books concerned with his own field. If he is a member of a technical society that publishes a journal, he receives copies of that journal.

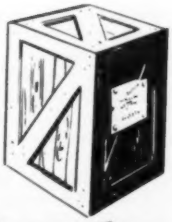
When a survey of a field is to be made, the scientist and the technician naturally turn to indexes of this field. An organic chemist refers to *Beilstein*, a physicist to *Science Abstracts;* but the motion-picture engineer has no single index which can be examined; rather he must search through several of the well-established indexes of photography and cinematography.

One of the most important of the photographic indexes of the world that includes much cinematography is the quarterly known as "Photographic Abstracts" that has been published by the Royal Photographic Society of Great Britain since 1921. Two Decennial Indexes of these abstracts have now appeared; the first was issued in 1932 or 1933 and covered the years 1921 to 1930. The second ten-year index covers 1931–1940 and has just been published in 1956. A third, for 1941–1950, is now in progress.

This second Decennial Index is made up as follows: Author Index, 70 pp.; Patent Index, 48 pp. (including British, Canadian, French, German and United States patents and one Russian patent); and a Subject Index, 91 pp. To use the Patent Index, one must know the patent number as the index contains no information on the subject of the patent. The Subject Index, however, contains references to patents. In the Subject Index, all main headings are set in full caps and bold-face type and, therefore, are easily found.

This volume is printed clearly and bound securely. The labor involved in the preparation of any index is very great and it is to be hoped that this useful compilation will be referred to frequently.—*Glenn E. Matthews*, SMPTE Editorial Vice-President, Bldg. 59, Kodak Park, Eastman Kodak Co., Rochester 4, N.Y.

A bibliography of titles of technical books on audio-visual, telecasting and motion pictures has been compiled by S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19, and 6331 Hollywood Blvd., Hollywood 28. The bibliography includes such topics as Advertising, Industrial and Commercial Applications; Sound Recording and Reproducing; Educational and Informative; Writing, Production and Editing Techniques; Laboratory Practices and Procedures; Photography and Cinematography; Electronics Theory and Practice; Theater, Screening Rooms and Projection Methods; and TV Studio and Engineering Aspects. The bibliography is available without charge.



new products

(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

A 3-dimensional color TV system, announced as the "world's first" by General Electric Co., Schenectady, N.Y., has been developed for remote servicing of reactors used in research for a nuclear aircraft propulsion system. The "first" refers to the use of color in a stereo system. The system was developed for the company's Aircraft Nuclear Propulsion Dept., Evendale, Ohio, and is not, in its present stage, adaptable for other than closed-circuit uses.

In use, the TV camera will be positioned inside the radioactive area. The viewing screen will be located a considerable distance away, behind thick shielding walls and near the controls of a mechanical manipulator. Movements of the manipulator inside the radioactive area will be directed by a technician from the 3-D color picture appearing on the screen. The technician will view this picture through special polarizing glasses similar to those used with recent 3-D motion pictures. Included with manipulator controls will be one used to aim and focus the twin lenses of the camera.

The observer's viewpoint is effectively transferred to that of a camera equipped with a dual-optical system having perspective similar to that of the two eyes of the observer; however, instead of presenting the pictorial image to two sensitive surfaces, as the human eyes do, the stereo-TV system presents two images to a single sensitive surface, a TV tube, on a time-sharing basis.

The frequency of the time sharing is at the picture rate of the TV system, in this case 90 pictures/sec. by alternating 45 pictures/sec for each eye, engineers have eliminated any objectionable flicker. A rotating shutter in the special color-TV camera alternately transmits the scene as viewed from two points to the camera's tube. The distance between the two points corresponds approximately to twice the distance between a person's eyes.

In the viewing console, light from the television image formed on the cathode-ray tube passes through a drum composed of alternate segments of polarizing filters with axes of polarization at right angles to each other. The drum revolves in synchronism with the TV frame rate of the camera and polarizes alternate frames vertically and horizontally. Thus all left-eye pictures are polarized in one direction and all right-eye

pictures are polarized in the other direction.

An observer viewing the screen — with his polarized spectacles — sees the left optical path with his left eye and the right optical path with the right. The 45-frame/sec rate gives him stereovision without an objectionable flicker.

A new television screen developed by Dr. Charles Feldman in the Naval Research Laboratory, Washington, D. C., as part of a program for improving aircraft instrumentation is expected to have far-reaching effects on the TV industry.

The basis for the new screen is a process of depositing phosphor on the face of the TV tube in the form of a thin transparent film instead of the opaque white powders now in use. The research which brought about this development was aimed at improving the quality of daylight viewing. In addition to achieving this goal, a resulting simplified approach to color television is expected to contribute to the development of 3-dimensional viewing.

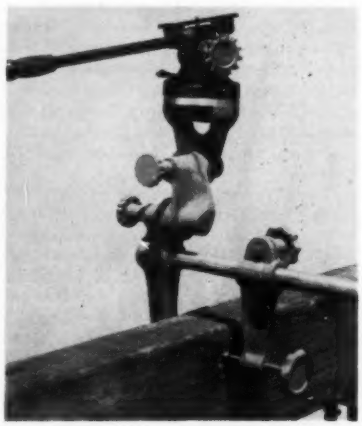
In applying this process to color TV, phosphor films that create different colors can be deposited one on top of the other and may be lighted separately or mixed by controlling the speed or direction of the electrons in the tube. By using one film of each of the three primary colors, the complete color spectrum can be obtained by proper mixing.

Initial research had the purpose of developing a transparent luminescent screen for use in the cockpit of an airplane. Part of aircraft development is aimed at replacing the present windshield with a thin transparent display medium which will enable the pilot simultaneously to receive visual and electronic information.

The process of producing the screen involves the evaporation of the highest grade commercial phosphorus in a vacuum bell-jar system. It is then condensed on a heated glass surface, with precautions being taken to eliminate all sources of impurities. The phosphorized glass is then fired and baked.

Detailed descriptions of the process and the steps taken in the research leading to the discovery will be presented by Dr. Feldman at the Society's Fall Convention in Philadelphia. Before accepting the Navy assignment, Dr. Feldman's main interest had been in basic research in solid state physics.

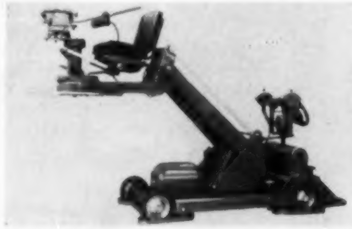
Moeller Anamorphic Lenses for 8mm and 16mm wide-screen motion-pictures are distributed by Paillard, Inc., 100 6th Ave., N.Y. 13, manufacturers of Bolex equipment. The lenses attach by bracket to cameras and projectors. The system gives a 1½ time expansion factor. The ratio is 2:1. For the 16mm camera the system has a focusing range of 3 ft to infinity. It can be mounted in front of the Switar 16mm, the Switar, Pizar and Lytar 1-in. lenses, the Yvar 3-in. and 4-in., as well as the standard and telephoto lenses of other makes provided their front diameter does not exceed 30mm. The same anamorphic lens is used in front of a regular projection lens with a focal length of 30mm or more. Two lens systems are available for the 8mm camera, focusing or fixed focus. The focusing model has a range of 2 ft to infinity.



The Cinekad Camera Clamp uses a C-type bracket to fasten a motion-picture camera to restricted locations such as trees, windows, wild life shooting hide-outs, wind tunnels or rockets. The head of the clamp revolves and tilts in all directions and accommodates 16mm and 35mm cameras. It is made in two models: C-16 which will take a load up to 60 lb; and C-35, to 120 lb. Further information is available from Cinekad Engineering Co., 763 10 Ave., New York 19.

A license agreement on certain aspects of Electrofax has been granted by Radio Corp. of America to Photo Research Corp. of Hollywood. Karl Freund, President of Photo Research, recently announced his

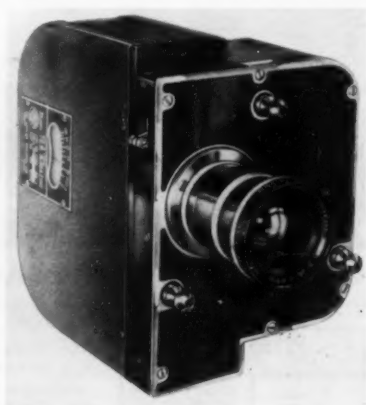
firm's entrance into communications electronics and related fields. Photo Research has been primarily engaged in manufacturing light-measuring instruments, a field in which Dr. Freund has been an active inventor. Other activities have been optical engineering and electronic instrument development. Electrofax, as a new improved process of magnetic printing, is involved in some of the firm's new activities.



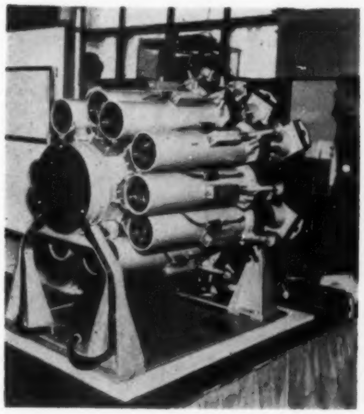
The Mark II is a new version of the power-operated camera crane truck for television made by W. Vinten Ltd., London, Eng. The new equipment is reported to be more flexible than the original with greater speed range. A 10-speed control for forward and backward tracking permits a maximum speed of approximately 150 ft/min and a minimum of 27 ft/min with a further reduction possible by application of a foot brake.

The truck is operated by two $\frac{1}{2}$-hp electric motors which drive the rear wheels and a $\frac{1}{2}$-hp motor operating the jib. Maximum height is 6 ft 3 in.; minimum, 1 ft 11 in. Maximum length is 11 ft 9 in; approximate weight, 1742 lb. It has a turning circle of 15 ft 6 in. The entire camera head and the operator's seat can be rotated through 360°, with provision for control by applying friction and also by a positive lock. The equipment is designed to operate 110-v d-c, and a rectified unit is available. Further information can be obtained from Cinematograph Export Ltd., 715 N. Circular Rd., London N.W.2, Eng.

Type 232 Mark 7 Instrumentation Camera, designed for automatic recording on 35mm film over a wide range of exposure and interval times, is a product of Canadian Applied Research, Ltd., 1500 O'Connor Dr., Toronto, Can. The camera is designed for flexibility in instrumentation and all types of air photography. The new camera forms the basis for a series of cameras, the



main components and assemblies of which are made on the module system for ease in conversion from one type of camera to another. Dimensions are $7\frac{1}{4} \times 5\frac{7}{8} \times 6\frac{1}{4}$ in. The weight is $13\frac{1}{4}$ lb.



Two devices having application to high-speed photography were exhibited at the British Physical Society Exhibition held last March in London. The Armament Research and Development Establishment of Great Britain exhibited a high-speed camera and the Cavendish Laboratory, Cambridge, exhibited an instrument for automatic calculation of tracks of nuclear particles.

The high-speed camera, which is actually an assembly of 12 cameras, takes pictures with exposure times as short as a ten-millionth of a second and at intervals of between a fraction of a millionth and a thousandth of a second. The timing is entirely electrical. The camera was designed primarily for studies of the early stages of explosions. It can also be used with artificial illumination supplied by a high-intensity light flash.

The large number of photographs available showing the tracks of nuclear particles presents a problem to the physicist. To use the new device, the operator need only line up corresponding points on pairs of stereo-photographs and press a button. The instrument then punches out on teleprinter tape all the information needed for calculation. The tape is then fed into an electronic computing machine which calculates automatically the lengths, angles and curvatures of all tracks.

Twenty cameras are used in a TV system that enables test engineers to observe static test firings of high-thrust, liquid propellant rocket engines. The tests are being carried out by Rocketdyne, a division of North American Aviation, Inc., 6633 Canoga Ave., Canoga Park, Calif., at the company's Propulsion Field Laboratory in the Santa Susana mountains. The cameras are shock-shielded on permanent mounts and are remotely controlled from the test stands. Mounted at 120° angles from the stands, the TV cameras monitor test firings at close focus, enabling engineers to get an unrestricted view of the engine's performance during "hot tests."

Ten independent distributors have been appointed to represent the industrial TV products line recently announced by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. They are: Audio Equipment Co., Detroit; Engineered Electronics, Inc., Pittsburgh; Hunter and Bell, Inc., Buffalo, N.Y.; A.B. Loudermilk Co., San Francisco; John A. Morefield Co., Camp Hill, Pa.; New Jersey Communications Corp., Kennilworth, N.J.; Research Instruments Corp., Richmond, Va.; Sound Systems, Inc., Long Island City, N.Y.; J. H. Sparks, Inc., Philadelphia; and TESCO Telephone Electronic Sound Corp. St. Louis.

Anscochrome Professional Camera Film Type 242, a 16mm motion-picture color film has been announced by Ansco, 175 Clinton St., Binghamton, N.Y. It is a soft-gradation, fine-grain color film with an Exposure Index of 10 under 3200 K illumination. Additional information can be obtained from Ansco Sales Offices in New York, Hollywood or Binghamton.

Special Gaumont-Kalee sound equipment has been designed, built and installed by Rank Precision Industries Ltd. for the Michael Todd film, *Around the World in 80 Days*, shown at the Astoria Theater in London. The film shown at the Astoria has the sound and picture on separate films.

The projection equipment is linked to six individual Gaumont-Kalee "21" amplifier channels, and sound from the screen is reproduced through five large Duosonic speaker assemblies. The effects channel incorporates a modified integrator unit and three separate power amplifiers feeding the more than 40 effects-speakers situated to the rear, above, and to the sides of the audience.

The projection equipment made especially for this "CineStage" production is based on the "21" projector, with water-cooled picture gate adapted for the special film and with Mole-Richardson, Gaumont-Kalee high-power arcs with their self-contained water circulating system. Each projector is mounted on a tandem-drive assembly linked by selsyn power transmitter to a studio-type follower head capable of reproducing the recording on 6-track film. Modification has been made to the lens-holders to accommodate special lenses. The projector installation also included the provision of special stands giving a lower optical center.

Bulletin 34 and 35 in the "Sound Talk" series are now available from the Minnesota Mining and Mfg. Co., Dept., M7-181 St. Paul 6, Minn. Bulletin 34 is 5 pp. on "Various Aspects of Tape Noise" and Bulletin 35 is 4 pp. on "Physical Limitations of Magnetic Tape" discussing the effects of heat, humidity and tension on magnetic tape.

Industrial Sound Films, Inc., is a new firm located in Atlanta, Ga. Owners are George M. Kirkland, President of International Sound Films; and H. McKinley Conway, Jr., President of Conway Publications, both of Atlanta. The new company will offer industrial film production services and will supply field camera crews, script and soundtrack personnel and technical and research facilities.

The Mixer Magnesound has been announced by Victor Animatograph Corp., Plainville, Conn. The attachment will be produced in the Plainville plant of Kalart Co., with which Victor Animatograph recently became affiliated. Designed to permit magnetic film recording and playback on all Victor 16mm optical sound projectors, major components include a magnetic sound drum incorporating separate record-playback and erase heads, microphone, and magnetic amplifier. The equipment is available through Victor distributors and lists at $199.45.

Kinoptic Apochromats, lenses for 16mm cameras, are distributed in the United States by Karl Heitz, Inc., 480 Lexington Ave., New York 17. The lenses, which are described as providing correction of all primary colors, are in a matched series ranging from 12.5mm up to 500mm. Prices range from $169 for 25 mm $f/2$ to $499 for 500 mm $f/5.6$.

"Let's Cover the Broad Facts About Narrow Tooth Sprockets" is the subject of Bulletin No. 10 available without charge from Charles H. Thonsen, 3124 Homehurst Ave., Pittsburgh 34. The one-page bulletin discusses the advisability of re-grinding 35mm sprockets to narrow-tooth type.

Fotoptica, Sao Paulo, Brazil, has announced the completion of its new photographic laboratory which offers all types of professional photo finishing services. The laboratory specializes in prompt attention to tourists' requirements and offers many professional services including microfilming, printing and reduction of motion-picture films.

Gordon Enterprises, 5362 N. Cahuenga Blvd., N. Hollywood, is conducting a series of workshop sessions for military personnel. The first session was attended by Naval Reserve photography specialists who visited the plant as part of a 2-week conference held at the U. S. Naval Air Station, Los Alamitos, Calif. Topics covered in the sessions will include a discussion of emergency repairs while in flight, and demonstrations of repair services performed at the plant. Discussions of equipment will include intervalometers, stereo viewers, various types of aerial cameras, high-speed and radar cameras, aerial lenses and shutters.

Standard Electronics, 29-01 Borden St., Long Island City 1, N.Y., a division of Dynamics Corp. of America, has announced that it has leased a newly constructed building of 170,000 sq ft to house its communications operations, including the recently acquired stock of Radio Engineering Laboratories, Inc. The company manufactures various types of communications equipment including television transmitters and amplifiers for the broadcasting industry.

"Audio Frequency Equalizers" is a 16-page catalog issued by Cinema Engineering Div., Aerovox Corp., 1100 Chestnut St., Burbank, Calif. The catalog contains product illustrations and charts showing response characteristics, dialogue and variable equalizer diagrams. It also includes eight case studies which describe actual problems and their solutions. The catalogue is available upon request to the company's manager, James L. Fouch.

Aerovox-Pacific, 1100 Chestnut St., Burbank, Calif., will act as the Southern California sales office for Aerovox Divisions which are in New Bedford, Mass.; Olean, N.Y.; Myrtle Beach, S.C.; West Orange, N. J.; Burbank, Calif.; and Santa Ana, Calif. Aerovox-Pacific will handle product sales of Aerovox Cinema Engineering Division through the already established Cinema sales representatives and export division. Products under the new sales setup will include Aerovox carbofilm resistors, modules, filters and capacitors, H-Q capacitors, Crowley ceramic products, Cinema Engineering wire-wound resistors, equalizers, instrument switches, audio equipment and magnetic degaussers.

Bell Telephone Laboratories, 463 West St., New York 14, have announced the development of new ferrite materials having properties particularly well adapted for a broad range of microwave applications. The desirable properties include controllable saturation magnetization, low dielectric loss, and a high degree of reproducibility. The new materials are essentially magnesium, manganese, aluminum ferrites or nickel manganese ferrite with a small amount of copper replacing some of the magnesium or nickel. Microwave measurements on the new ferrites indicate that in general they are comparable to or better than similar materials containing no copper. Applications include microwave gyrators, isolators and similar devices.

General Precision Laboratory's new test building was formally opened June 3 at Pleasantville, N.Y. Completed at a cost of $450,000, the 23,200 sq ft building contains facilities for testing military and commercial electronic equipment. Devices to simulate extremes of temperature, altitude, humidity, acceleration, vibration and shock are used in the testing.

An 8mm automatic motion-picture camera, reported to be the first to use light energy alone to power the lens-setting mechanism, has been introduced by Bell & Howell Co., 7100 McCormick Rd., Chicago 45.

The current is transmitted directly from the photoelectric cell to a mechanism controlling the lens iris. No batteries, motors or springs are used for the exposure setting. The electric eye, which adjusts to changing light faster than the human eye, sets the lens for proper exposure before the starting button is touched. It can operate the lens through its full range from $f/1.9$ to $f/16$ in less than one second.

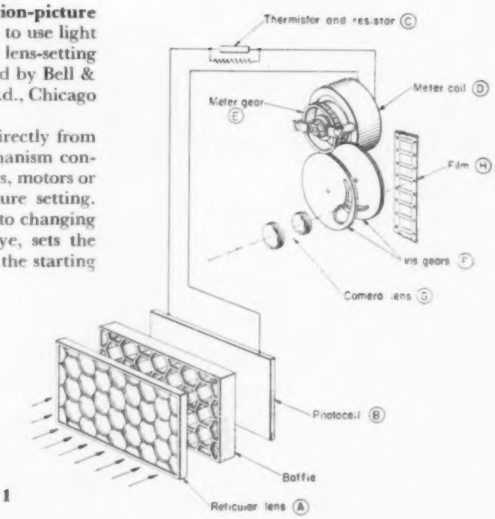


Figure 1

The camera can also be operated manually when it is desirable to set the lens for under- or overexposure for special effects.

Figures 1 and 2 show how the camera operates. The light enters the reticular honeycomb lens combined with a baffle (A), its angular coverage controlled to match the coverage of the camera lens. The light then reaches photocell (B) and generates an electric current (the more intense the light, the stronger the current). The electric current flows through an electrical circuit, passing through a resistor and thermistor (C) which compensate the current for temperature variations.

When the current reaches the meter coil (D) it rotates or deflects the meter according to the strength of the current. On one end of the coil is the meter needle or needle pointer on the face of the camera. A gear

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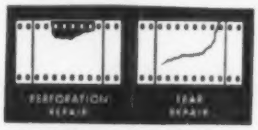

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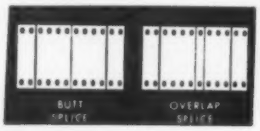

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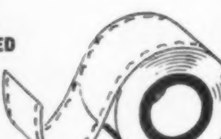

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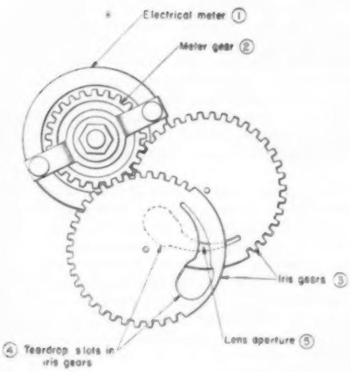


Figure 2

on the meter (E) engages the two iris gears or blades which create the iris opening (F). The rotation of the meter opens or closes the iris. The iris opening now permits the exact amount of light for correct exposure to come through the lens (G) to the film (H). All this has taken place in the fraction of a second.

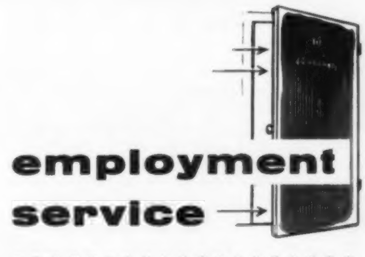
Figure 2 shows how the iris gears or blades form the lens aperture. In the electric meter (1) the meter gear (2) rotates according to the current generated by the photocell.

A clockwise rotation from the point shown in the illustration will cause a counter-blockwise rotation of both iris blades (3). Each iris gear or blade has a "teardrop" slot (4). The points where the slots overlap creates the lens aperature (5). A counterclockwise rotation of the iris blades cause the aperture to enlarge. If the meter rotates counterclockwise from the point shown in the drawing, there will be a clockwise rotation of both iris blades and the aperture will decrease in size.

Dimensions of the camera are: $5\frac{3}{4}$ in. high, $4\frac{3}{4}$ in. deep, $2\frac{3}{4}$ in. wide, weight $2\frac{1}{4}$ lb. It uses an 8mm roll with a film capacity of 50 ft. Camera speed is 16 *f*/sec. It is priced at $169.95.

Bell & Howell also announces a new 16mm camera, the 240EE, which it claims is the world's first spool-loading motion-picture camera to incorporate a photoelectric cell for automatic exposure setting. Otherwise the new model embodies the same features as Bell & Howell's regular 240 line, including a 32-ft spring run and completely automatic threading. The price is $329.95.

The RCA Components Division has issued a 22-page brochure, "RCA Electronics Components," describing electronic components and test equipment sold through distributors. Included are photographs and illustrations covering new line service test equipment and accessories. The test equipment section presents application information and operating capabilities for service, commercial, school and laboratory use. The brochure is available to RCA Components Division independent distributors through their RCA representative or from the Division's office at Camden, N.J.



These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Film Writer-Editor, with directorial experience, now engaged in post-graduate work at City College Institute of Film Techniques. Three years experience in direction of off-Broadway theater. Has written scripts for NBC-TV and industrial films. Experienced with all 16mm cameras and editing equipment. Formerly with Screen Gems, Inc. Willing to relocate. Write: Lawrence G. Cohen, 55 Nagle Ave., New York 40.

Producer-Director-Cinematographer. Comprehensive background in all phases of motion-picture production: creative, technical and artistic. More than 13 years in motion-picture, live-television and radio production. Independent producer 6 years. Experience also includes writing, editing, acting and narration. Very fluent Spanish including technical terms. Desires position with production company or in motion-picture department of large industrial corporation. Interested in the United States, Central or

South America. Résumé available in English or Spanish. Write: Oliver E. Cain, P.O. Box 1594, Amarillo, Texas.

Stereoscopy. Seeking opportunity for research and development work in phases of motion-pictures and television leading to an accurate reproduction of the illusion of life such as stereoscopic sight (unaided), binaural sound, smell, etc. Have done independent research for 10 yr and prepared book on integrated high-speed stereo. Robert B. Collender, 58 Van Reipen Ave., Jersey City, N. J.

Motion Picture Photographer. Presently employed with network affiliated television station as news photographer. Organizational ability, experienced in editing, news writing. Present position includes filming commercials and sales presentations, video slides, advertising and promotional stills. Interested in quality creative production. D. David Bash, 724½ Ostend Court, San Diego 8, Calif.

TV Technician. Young man, 27, mechanically inclined, single (but engaged), looking for a TV job with a future. Recent graduate of TV Workshop (finished in top three of class), thoroughly qualified dolly operator, boom operator, audio engineer, TV cameraman, floor manager, video operator, lighting (both as director and grip), and technical direction. Operate film camera and projector and know film processing and editing. Thorough knowledge of remote operations and theory and operation of microwave transmission. Knowledge of color TV principles and operations, scenery and special effects. Intend to secure 1st class license from FCC as radio-telephone operator. Arthur K. Hirshman, 2242 Bragg St., Brooklyn 29, N.Y. NIghtingale 6-3997.

Scientific Film Production. Producer with 12 years experience in production of medical training films and 13 years in still and motion-picture documentation of scientific research material seeks opportunity in studio specializing in scientific, research or educational motion pictures. Four Venice awards, including first prize for best natural science film in 1952. Fellow of the Royal Photographic Society. Wilbour Chace Lown, 306 West 11 St., New York 14. ALgonquin 5-8228.

Recording Director for Slide Films. Thorough knowledge available talent and recording techniques. R. Goldhurst, 913 Second Ave., New York, N.Y. PLaza 9-7654.

Motion-Picture Cameraman-Technician. Age 40, single with car, free to travel. 15 years experience in cinematography, B & W and color, including animation, titling and special effects. Thorough knowledge of 16mm and 35mm production equipment. Capable editor, experienced in laboratory developing, sensitometric control and printing. Commercial and college-unit production experience. B.A. degree; graduate of New Institute for Film and TV, New York. Active member SMPTE. Seeks position with commercial film producer, college unit, or internal industrial film group. References, complete resume on request. Joseph MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio. Tel: BR 6-2053.

TV Stage Manager. NYU graduate, worked with active motion-picture, TV and stage groups, presently employed as cameraman with Artists Enterprises, seeking position as program assistant or stage manager for TV studio. Resume on request. Write: Reg Gamar, 279 92 St., Brooklyn 9, N.Y.

Film Writer-Director now heading film unit large national organization. Administrative experience. Interested in connection with business film producer, film laboratory service department or industrial photo unit. Thorough knowledge all phases of film production including TV spots, animation techniques, public relations, sales and training films. Write: Film Director, 4410 Walsh St., Chevy Chase 15, Md.

Engineering and Technical Film Producer. Background in all phases of technological and industrial film production including direction, camera, editing, business management; presently and for many years producer with own company. Now seeking position that will allow concentration exclusively on production of technological films either with production company or large industrial corporation, preferably in the western states. J. K. P., 4003 Cumberland Ave., Hollywood 27, Calif.

Positions Available

Motion-Picture Development Engineer. Mechanical engineer or equiv. required by long-established motion-picture developing machine concern. Must be thoroughly familiar with machine design and construction and capable of supervising projects through manufacturing processes. Technical knowledge of color and spray processes desirable. Salary open. Send resume with references and salary requirements to: Filmline Corp., 43 Erna Ave., Milford, Conn.

Photographic Engineers. GS-11; \$6390/yr; requirements: engineering degree plus 2½ yr general engineering experience including 1 yr specialized experience in the photographic field. GS-12; \$7570/yr; requirements: engineering degree plus 3½ yr general engineering experience including 1 yr experience in the photographic field. GS-13; \$8990/yr; requirements: engineering degree plus 4 yr general engineering and administrative experience including 1 yr specialized experience in the photographic field. Contact Civilian Personnel Office, Employee Utilization Div., Bldg. 787, Fort Monmouth, N.J., as soon as possible. All positions will be located in vicinity of Fort Monmouth, with a minor amount of travel involved.

Visual Information Specialist. \$6390/yr. Requirements: 3 yr general experience in the information and editorial field in press, publication, radio or visual media; plus 3 yr specialized experience in the development and utilization of pictorial displays, film strips, three-dimensional static and mobile exhibits, still and motion pictures, charts, maps and graphs. Substitution: successfully completed education in an accredited college or university with major study including an average of 6 semester hr/yr in English composition or journalism may be substituted at the rate of 1 yr education for 9 months experience, up to 4 yr education for 3 yr general experience. Specific experience in engineering writing is desired. Apply to Employment Div., U. S. Naval Training Device Center, Port Washington, N. Y.

Motion-Picture Equipment Maintenance Men. Experience on 35mm Cameras helpful, but not absolutely essential. Our shop has openings for skilled machinists in 35mm projectors, arclamps generators, rectifiers, printers, processors, Movieolas, etc. Write fully to William Allen, S.O.S. Cinema Supply Corp., 602 West 52 St., New York 19.

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Meeting Calendar

Western Electronic Show and Convention, Aug. 20–23, Cow Palace, San Francisco. The technical program will offer 255 papers at 48 sessions.

Biological Photographic Association, Aug. 27–30, Kahler Hotel, Rochester, Minn.

IRE-AIEE Magnetic Amplifiers Conference, Sept. 4–6, Penn Sheraton Hotel, Pittsburgh, Pa.

American Physical Society, Regional Meeting, Sept. 5–7, Boulder, Colo.

American Chemical Society, National Meeting Sept. 8–13 New York.

Illuminating Engineering Society, National Technical Conference, Sept. 9–13, Biltmore Hotel, Atlanta, Ga.

Instrument Society of America 12th Annual Instrument-Automation, Conference and Exhibit, Sept. 9–13, Auditorium, Cleveland, Ohio.

Society of Photographic Scientists and Engineers, Annual Technical Conference, Sept. 9–13, Hotel Berkeley-Carteret, Asbury Park, N. J.

American Statistical Association, Annual Meeting of Section on Physical and Engineering Sciences, Sept. 10–13, Atlantic City, N. J.

American Institute of Chemical Engineers, Regional Meeting, Sept. 15–18, Lord Baltimore Hotel, Baltimore, Md.

American Society of Mechanical Engineers, Fall Meeting, Sept. 23–25, Statler Hotel, Hartford, Conn.

Standards Engineers Society, 6th Annual Convention, Sept. 23–25, Commodore Hotel, New York.

Institute of Radio Engineers and American Institute of Electrical Engineers, Industrial Electronics Conference, Sept. 24–25, Morrison Hotel, Chicago.

82nd Semiannual Convention of the SMPTE, Oct. 4–9, Sheraton Hotel, Philadelphia.

National Electronics Conference, Oct. 7–9, Hotel Sherman, Chicago.

American Institute of Electrical Engineers, Reliability and Quality Control in Electronics, Oct. 10, Silver Spring Md.

American Society of Civil Engineers, National Convention Oct. 14–18, Statler Hotel, New York.

Institute of Radio Engineers, Canadian Convention, Oct. 16–18, Toronto, Ont., Canada.

Acoustical Society of America, National Meeting, Oct. 24–26, Univ. of Michigan, Ann Arbor, Mich.

American Standards Association, Eighth National Conference on Standards, Nov. 13–15, San Francisco.

IRE, ASQC, AIEE, RETMA, Fourth National Symposium on Reliability and Quality Control, Jan. 6–8, 1958, Hotel Statler, Washington, D. C.

83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, 1958, Ambassador Hotel, Los Angeles.

Fourth International Congress on High-Speed Photography, including Equipment Exhibit, Sept. 29–Oct. 4, 1958, Cologne.

84th Semiannual Convention of the SMPTE, Oct. 20–24, 1958, Sheraton-Cadillac, Detroit.

American Standards Association, Ninth National Conference on Standards, Nov. 18–20, 1958, Hotel Roosevelt, New York.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–9, 1959, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D. C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1957 Journal.

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